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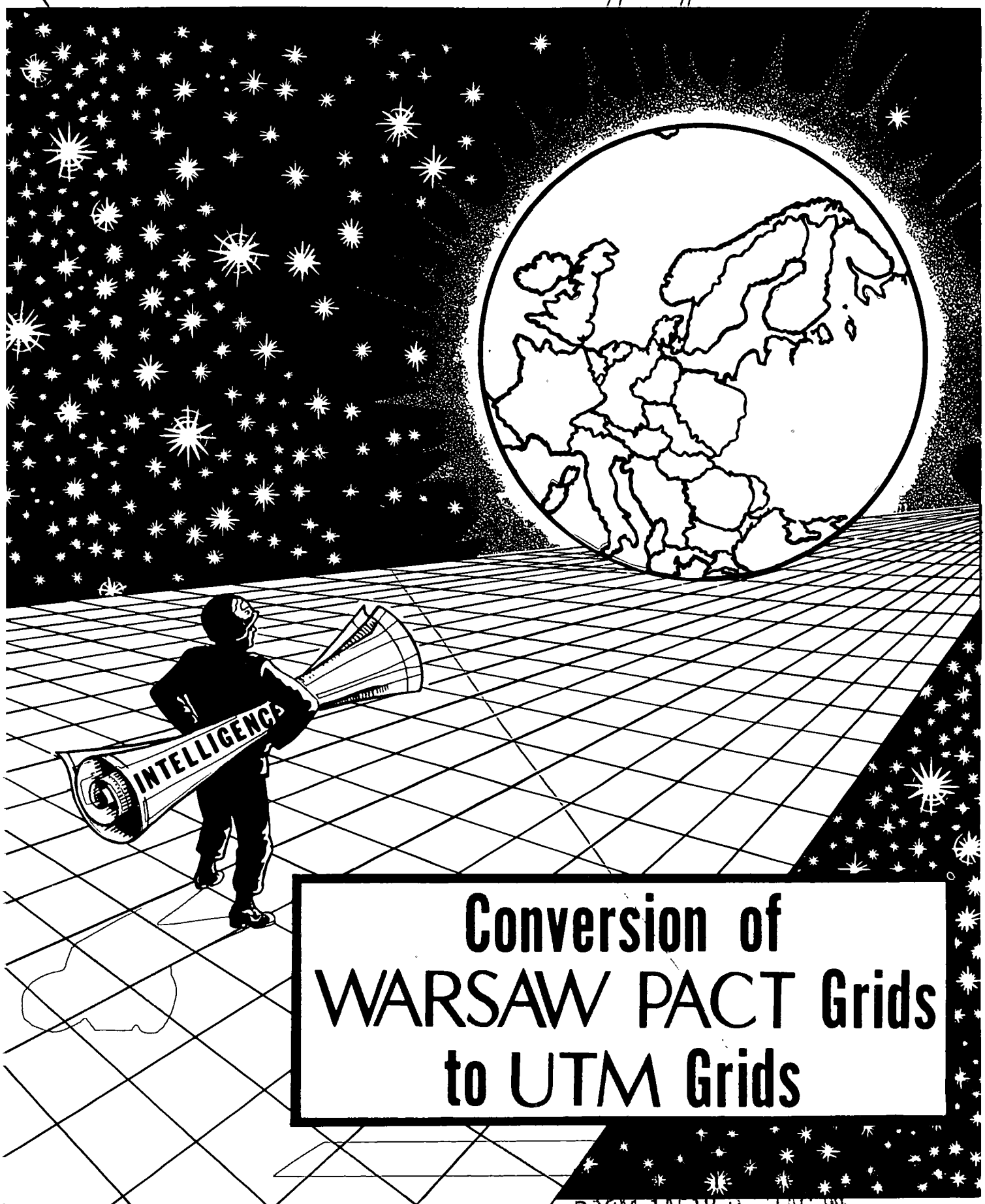

Conversion of WARSAW PACT Grids to UTM Grids

ROOM 1A518 PENTAGON
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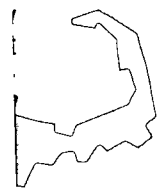
The term "Gauss-Krasovskij" as used in this manual refers to a Gauss-Kruger grid based on Pulkova 1942 datum Krasovskij spheroid.



WHEN USED IN THIS PUBLICATION, "HE", "HIM", "HIS", AND "MEN" REPRESENT BOTH THE MASCULINE AND FEMININE GENDERS.

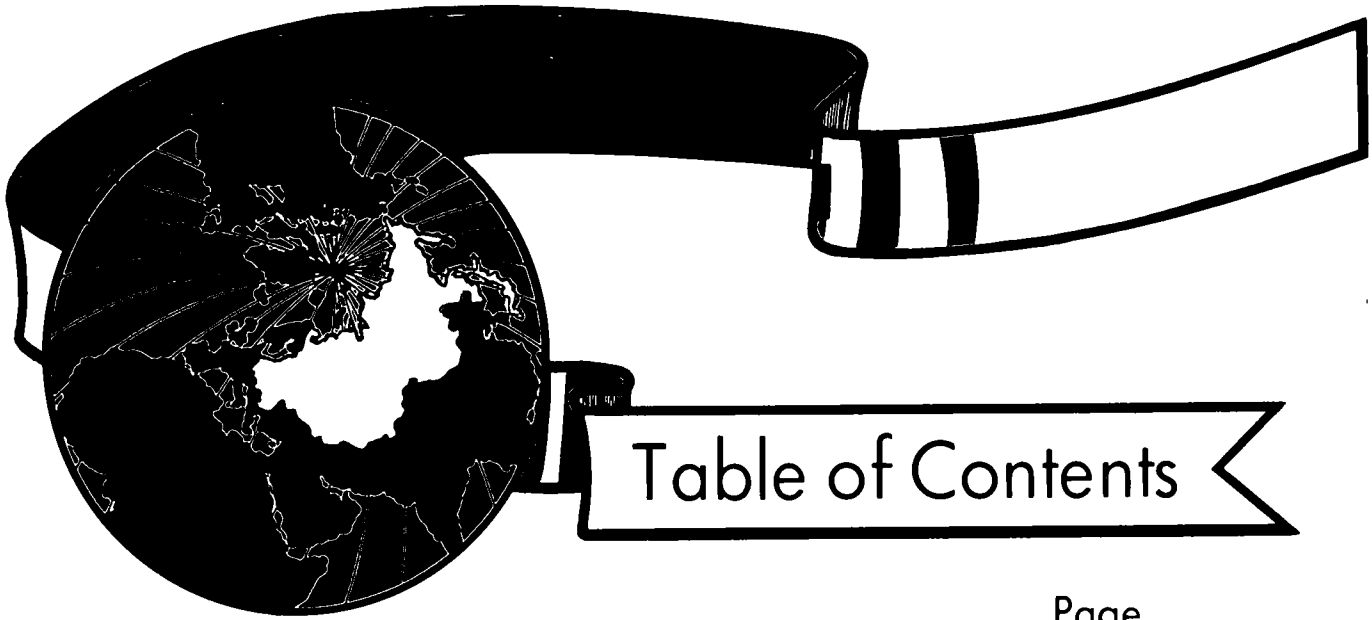
FIELD MANUAL
No 34-85

HEADQUARTERS
Department of the Army
Washington, DC, 25 September 1981

Conversion of WARSAW PACT Grids to UTM Grids

The armies of the Warsaw Pact, fashioned on the Soviet model, pose a formidable threat to North Atlantic Treaty Organization (NATO) forces in Eastern Europe. If a smaller NATO force is to win against a larger Warsaw Pact Army, our commanders must have every conceivable bit of information available so that they can accurately "see the battlefield." The purpose of this field manual is to familiarize military personnel, and especially intelligence analysts, with the Warsaw Pact grid system and to provide methods of converting Warsaw Pact coordinates to Universal Transverse Mercator (UTM) military grid coordinates. This FM is designed to be used as a general orientation for those unfamiliar with the conversion process and as a specific guide and reference for the soldier employing grid conversion. Prisoners of War (PW), captured documents, and communications intelligence (COMINT) are but a few sources for which the methods to convert Warsaw Pact grids to UTM grids are applicable and, in turn, would contribute to the needs of the tactical commander.

*This manual supersedes TC 30-48, 26 February 1979.



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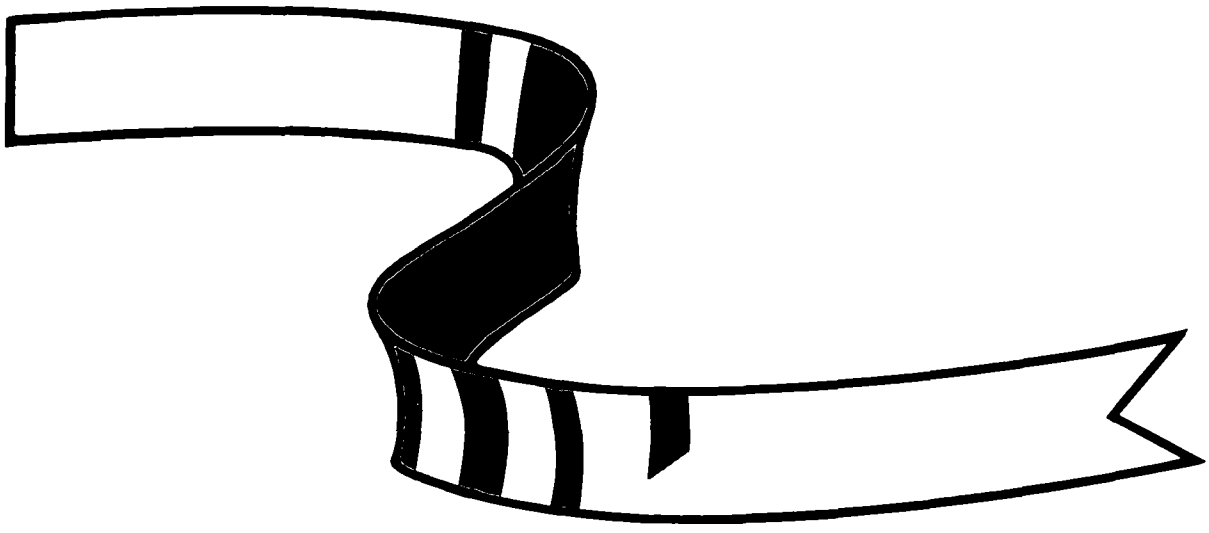

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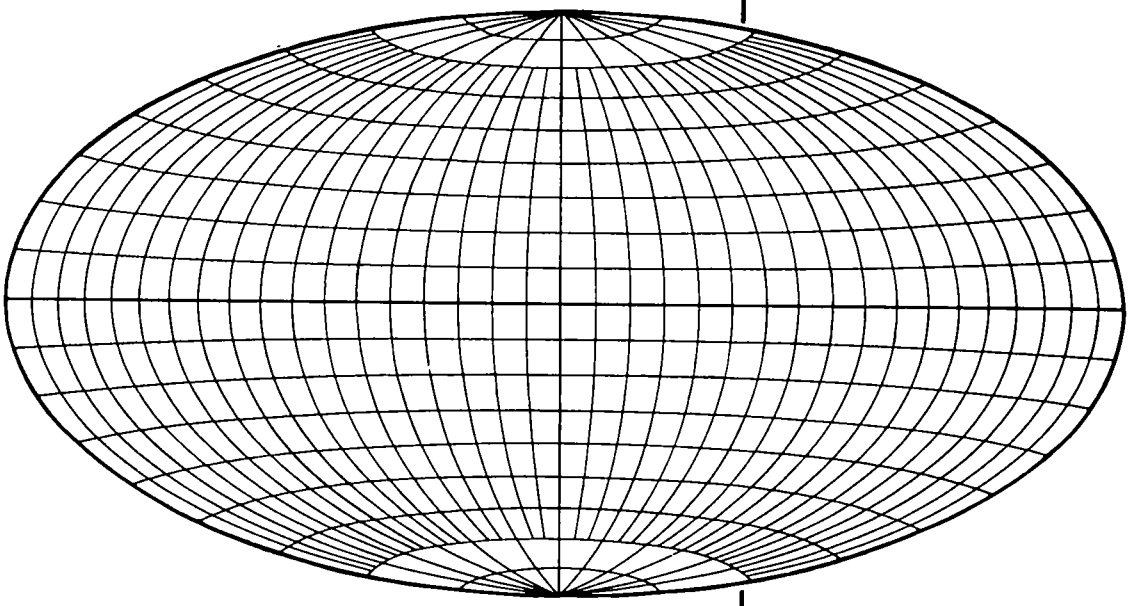
Chapter 1

UNIVERSAL TRANSVERSE MERCATOR MAPS

General

Universal Transverse Mercator (UTM) maps are used by the United States and other North Atlantic Treaty Organization forces and are based upon the Hayford spheroidal concept. This concept assumes (mathematically) that the earth bulges slightly in the area of the equator.



This spherical shape of the earth presents many difficulties when attempting to represent it as a flat surface. The inherent difficulty in the earth's representation may best be appreciated by covering a ball-shaped object with a sheet of paper. The only area that will be accurately represented upon the paper is that which is not folded to conform to the spherical shape. One of the methods devised to overcome this difficulty is the use of projection.

Projection

To project literally means "to throw forward." A map projection is the network of coordinates picked off the globe and thrown upon a surface. The Mercator projection is a mathematical projection very similar to what would be formed by projecting lines from the center of the earth to a cylinder. The cylinder fits around the earth and touches at the Equator (fig 1-1). If the image of the earth could be projected against the cylinder and fixed there, the cylinder could be cut open and laid out flat. This would result in a sheet map that is comparatively accurate in the equatorial region, but more and more distorted as the polar regions are approached. The point of tangency of the Mercator projection is a horizontal line — the Equator.

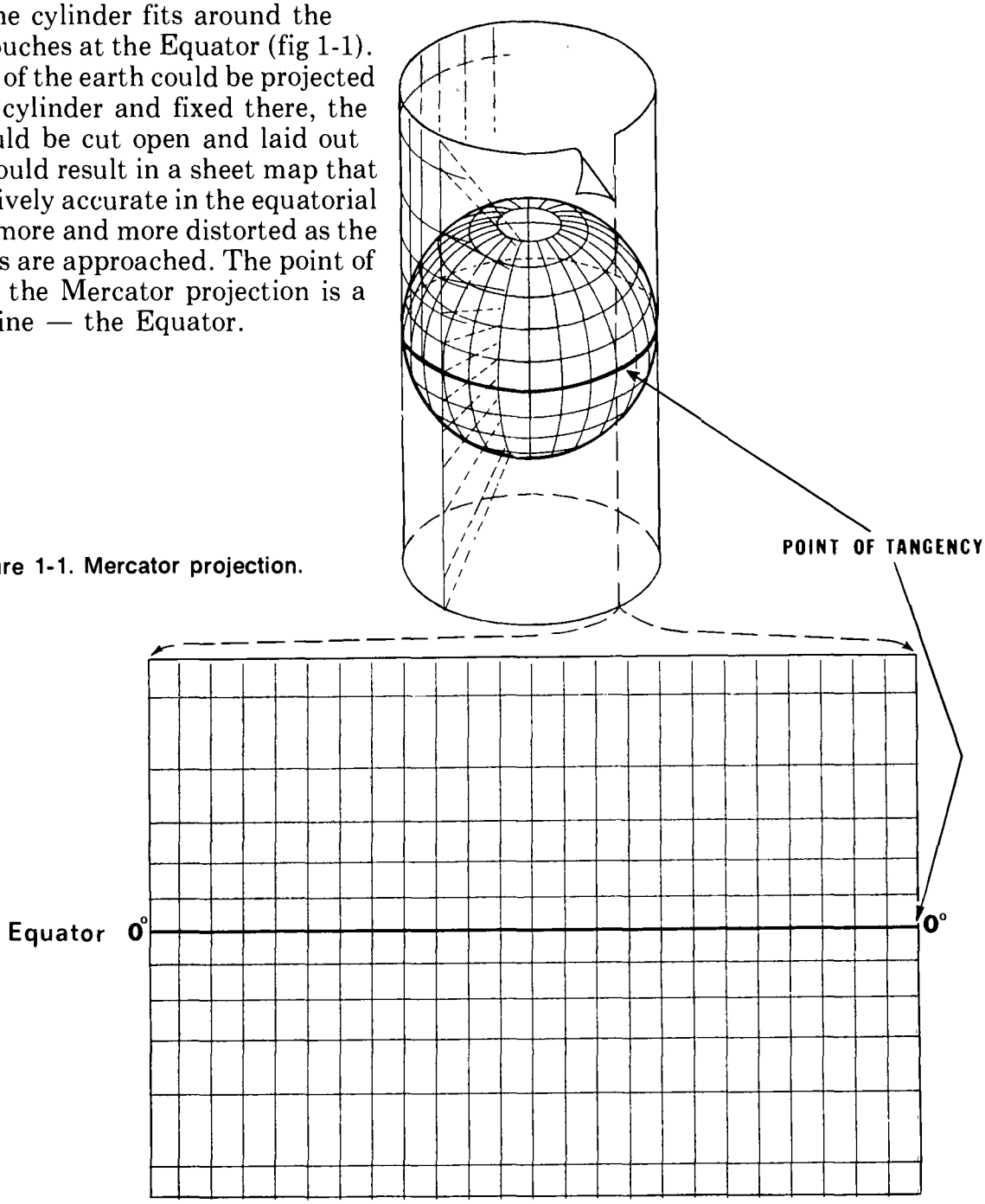


Figure 1-1. Mercator projection.

Turning the cylinder across its former horizontal line, that is transversing it, results in the transverse Mercator projection (fig 1-2).

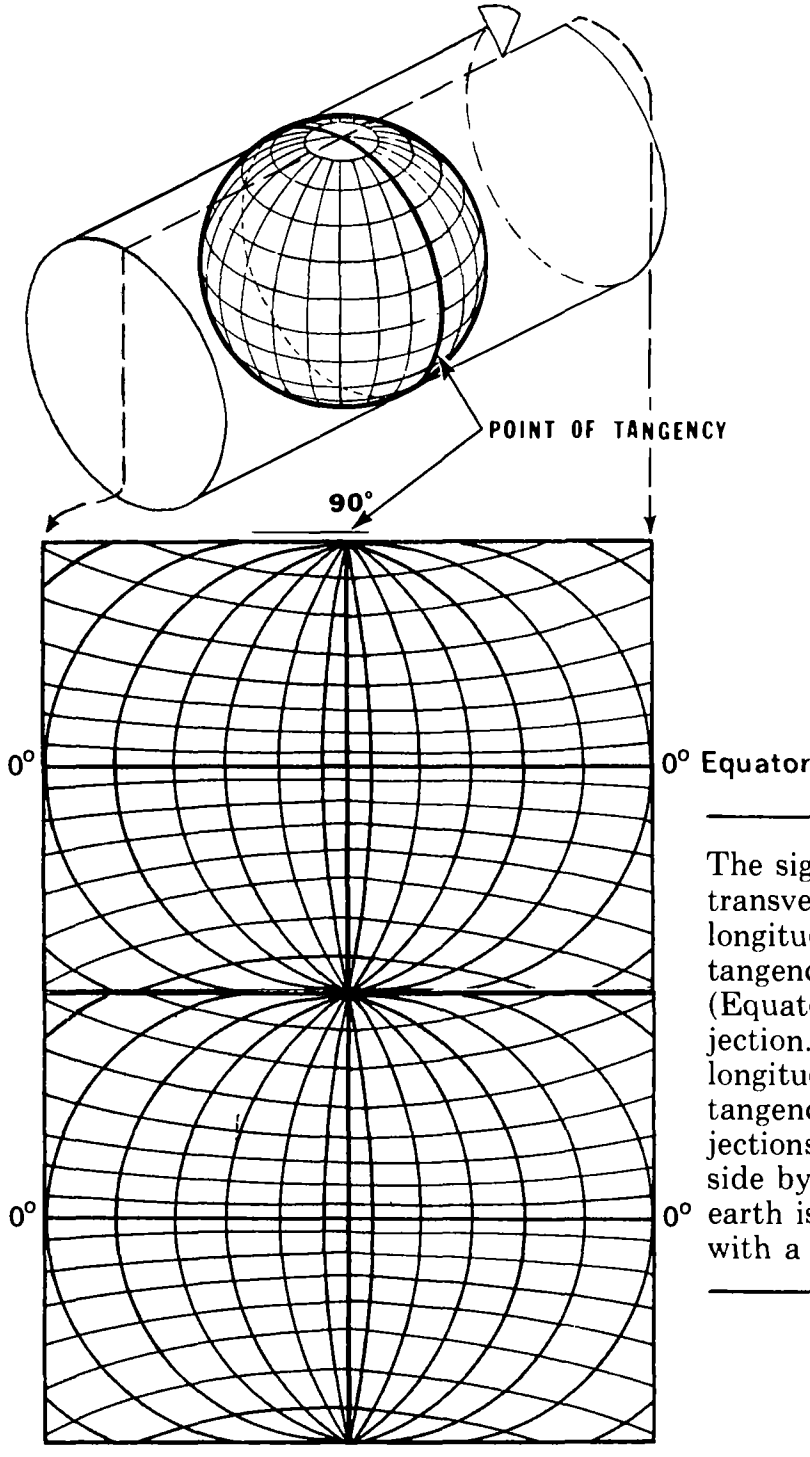


Figure 1-2.

Transverse Mercator projection.

The significant difference is that the transverse Mercator projection uses a longitudinal or a vertical line as its line of tangency in lieu of a horizontal line (Equator) used to project a Mercator projection. By choosing several lines of longitude or meridians as lines of tangency, several transverse Mercator projections can be constructed. When laid side by side, the entire land mass of the earth is mapped in north/south sections with a minimum of distortion.

Geographic Coordinates

A method used to locate specific points on a map by utilizing degrees of longitude and latitude is called the *geographic coordinate method.* By drawing a set of lines around the globe (parallel with the Equator) and another set of lines crossing the Equator at right angles and converging at the poles, a network of reference lines is formed from which any point on the surface of the earth can be located. Those lines parallel with the Equator are called *parallels of latitude* (fig 1-3). Those lines extending from pole to pole are called *meridians of longitude.* The meridian of longitude, from which longitudinal measurements are made, is called the *prime meridian.* The prime meridian of the system we use runs through Greenwich, England and is known as the *Greenwich Meridian.* Geographic coordinates are expressed in angular measurements. Each circle is divided into 360°; each degree into 60 minutes, and each minute into 60 seconds.

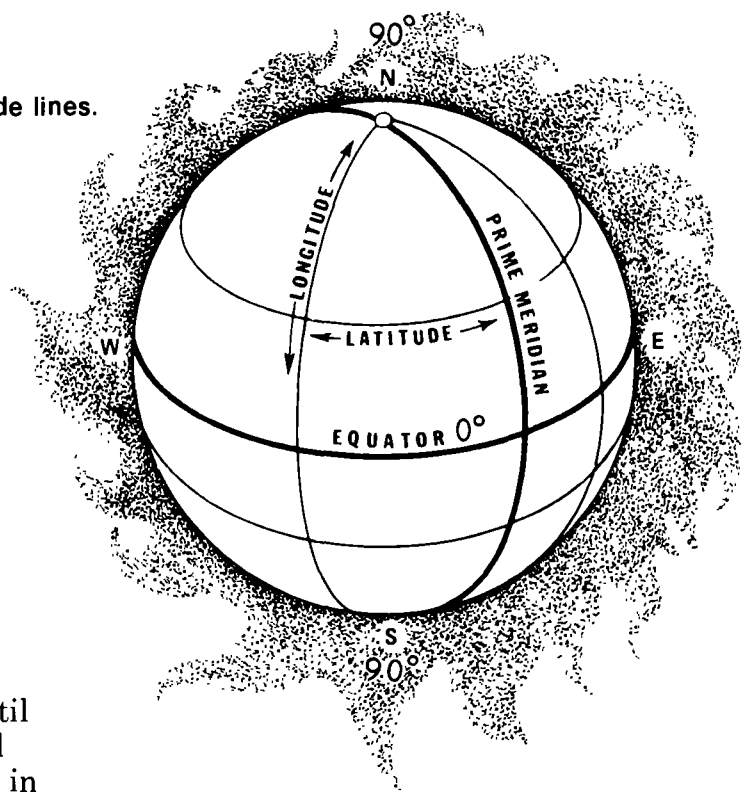


Figure 1-3.
Latitude and longitude lines.

The Equator is designated as *zero degrees* and measurements are made north or south of this line. The North Pole is 90° north latitude and the South Pole is 90° south latitude. To measure around the globe, one would start at the prime meridian and proceed both east and west around the globe until the 180° line is reached. Large and medium scale military maps have, in addition to geographic coordinates, a grid system for locating or referencing the locations of points. The grid system, rather than the geographic coordinates, is used by the military to express location because of its relative simplicity.

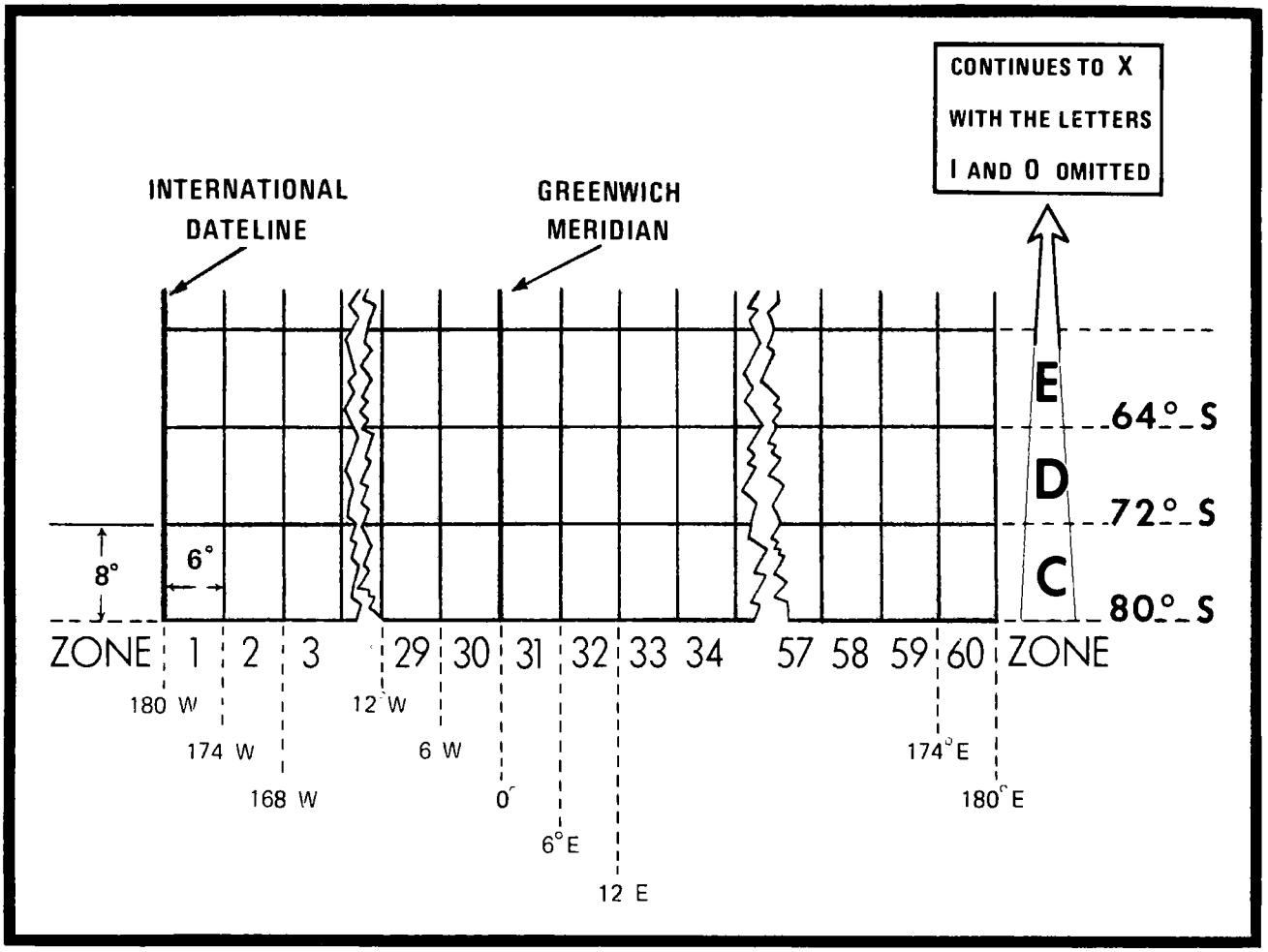


Figure 1-4. UTM military grid zones.

Universal Transverse Mercator Military Grid System

The Universal Transverse Mercator (UTM) military grid system uses the geographic lines of longitude to divide the globe vertically into grid zones. The zones are large regularly shaped geographic areas, each of which is given a unique identification called the grid zone designation. Initially a transverse Mercator is drawn for each zone. There are 60 zones completely encircling the globe, each being 6° of longitude wide. The zones are numbered 1 through 60, going in an easterly direction, with zone 1 beginning at the 180th meridian. Thus, zone 1 is from 180° W to 174° W; zone 32 is from 6° E to 12° E; zone 60 is from 174° E to 180° E (fig 1-4).

Going north and south from the Equator are horizontal lines of division for each zone (fig 1-5). From 80° S to the Equator, there are 10 rows in each zone, 8° high and 6° wide. From the Equator northward, there are 9 rows 8° high and 6° wide, with a 10th row 12° high and 6° wide. These zones become progressively narrower as they approach the poles; therefore, the **UTM military grid system is not used beyond 84° N and 80° S.** A polar projection is used to cover these areas. In the UTM military grid reference system, these horizontal zones are lettered south to north, beginning at 80° S with the letter "C" and ending with the letter "X" at 84° N. **The letters "I" and "O" are not used to avoid confusing them with the numbers one and zero.**

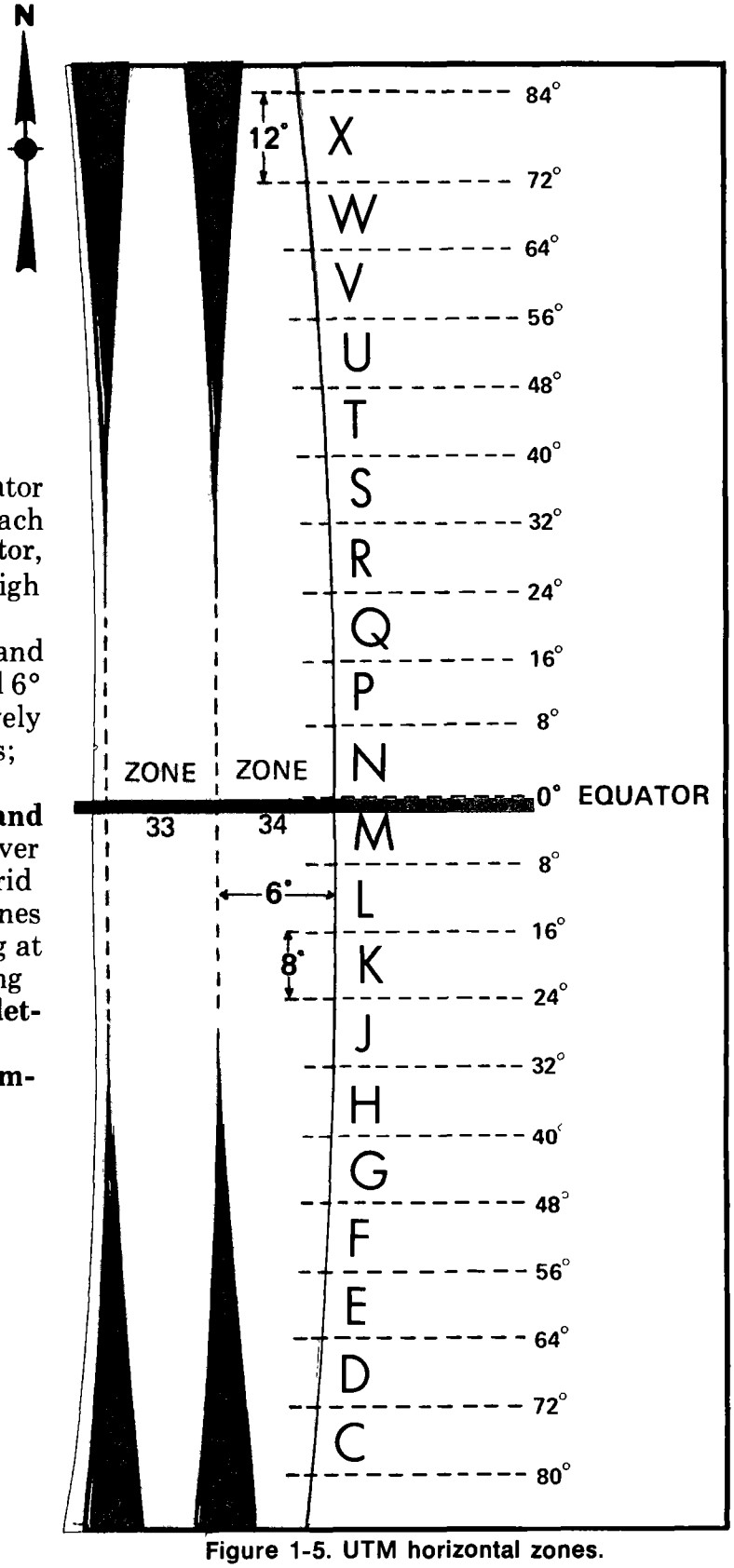


Figure 1-5. UTM horizontal zones.

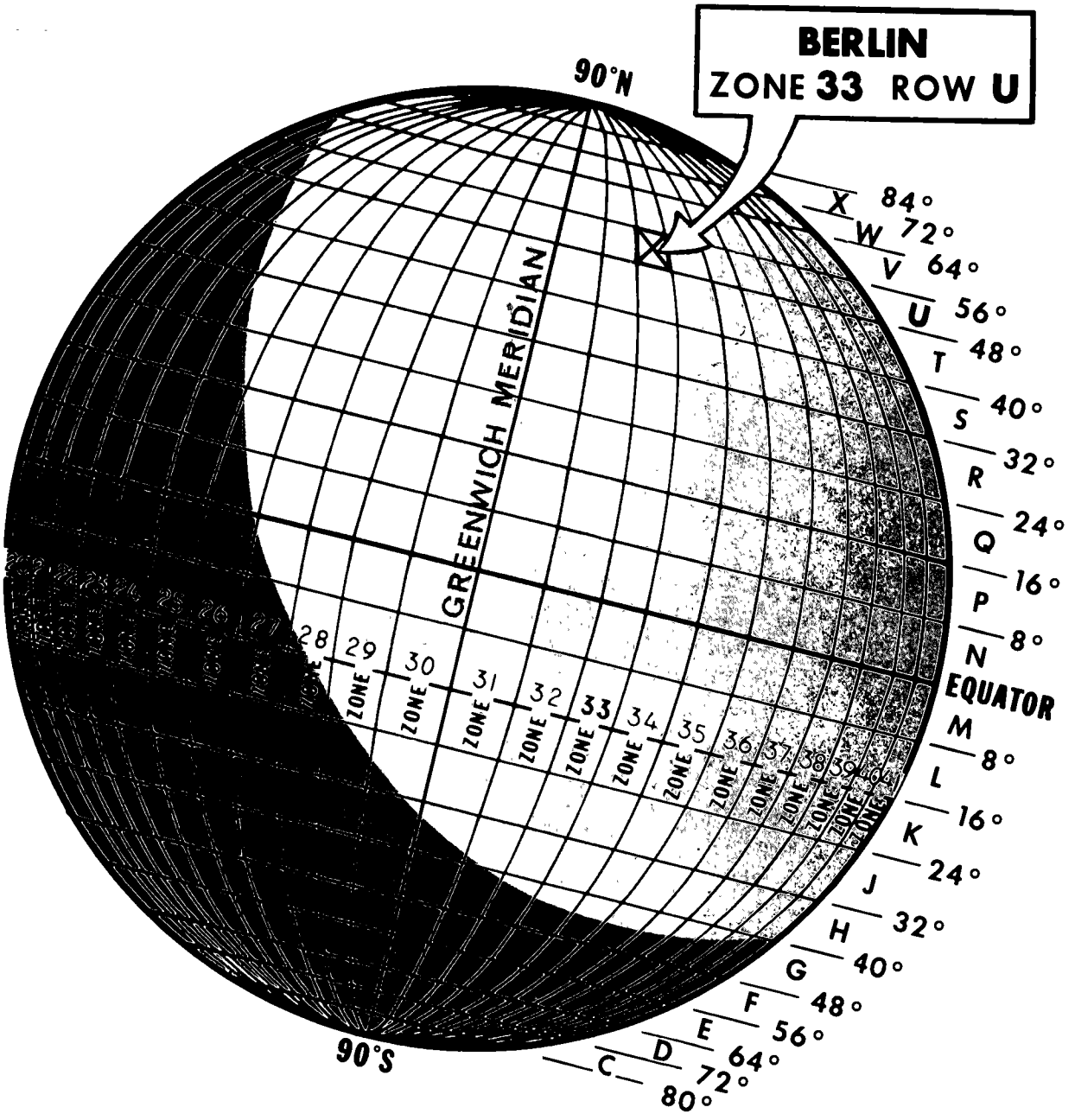


Figure 1-6. UTM method of designating major grid zones.

The grid zone designator for Berlin, Germany, for example, would be 33U; that is, zone 33 and row U on the UTM military grid reference system (fig 1-6).

Each 6° by 8° or 6° by 12° grid zone is then further divided by 100,000-meter squares, which are identified by the combination of two letters or digraphs (fig 1-7).

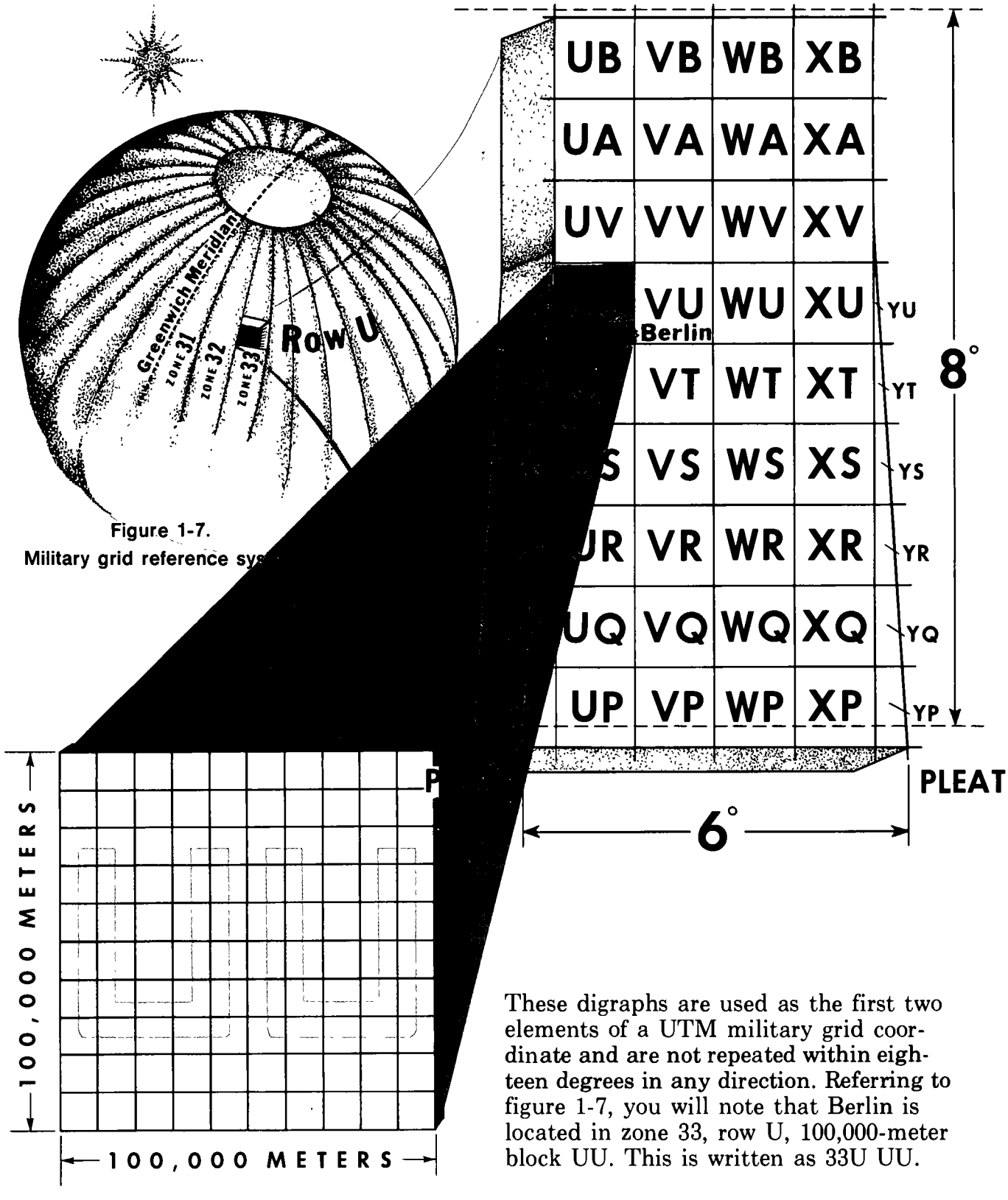


Figure 1-7.
Military grid reference sys

These digraphs are used as the first two elements of a UTM military grid coordinate and are not repeated within eighteen degrees in any direction. Referring to figure 1-7, you will note that Berlin is located in zone 33, row U, 100,000-meter block UU. This is written as 33U UU.

Each 100,000-meter square is further divided by grid lines which are placed at 10,000- or 1,000-meter intervals. Figure 1-7 illustrates that the 100,000-meter square UU can be divided into 100 of the 10,000-meter squares. Each 10,000-meter square within UU can then be further subdivided into 1,000-meter squares by dividing each side of the 10,000-meter square into 10 equal parts. This division will provide grid lines that are 1,000 meters apart. Through the use of a grid coordinate scale, division of the 1,000-meter square is possible, enabling the location of a point on the earth's surface to the nearest 10 meters.

In the subdivision of a 100,000-meter square, all readings are taken from the lower left-hand corner of the block. The location of any point within the block is stated as to how many meters it is to the RIGHT of the left-hand side of the block, and how many meters the point is UP from the bottom of the block. All UTM readings are given as easting portion first, and northing portion second.

The RIGHT and UP method can best be illustrated by figure 1-8. To determine the UTM location of point E, start at the left-hand corner of the grid square. Reading eastward, or RIGHT, to the vertical line that intersects point E, one would then read UP, or north, until point E is located on the horizontal line. The six-digit grid coordinate of point E is 355 RIGHT and 576 UP, or 355576.

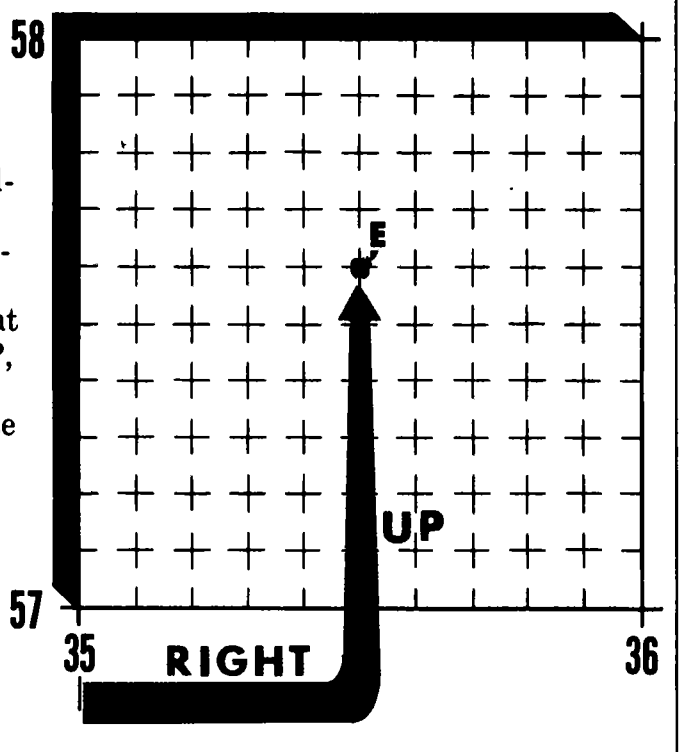
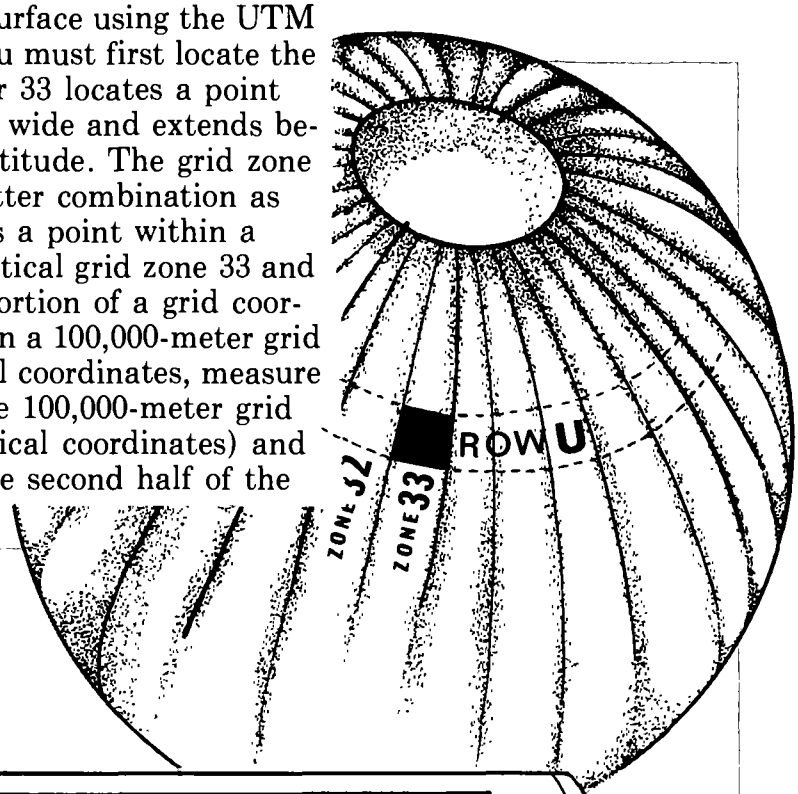


Figure 1-8. Military grid.

To locate any point of the earth's surface using the UTM military grid coordinate system, you must first locate the appropriate grid zone. The number 33 locates a point within zone 33 which is an area 6° wide and extends between 80° S latitude and 84° N latitude. The grid zone designation 33U, a number and letter combination as shown in figure 1-7, further locates a point within a quadrangle 6° wide by 8° high (vertical grid zone 33 and horizontal zone U). The digraph portion of a grid coordinate further defines a point within a 100,000-meter grid square. Finally, using the numerical coordinates, measure the easting metric value within the 100,000-meter grid square (the first half of the numerical coordinates) and then the northing metric value (the second half of the numerical coordinates).



The degree of accuracy is indicated as follows:

33U = a 6° by 8° area (grid zone designation).

33U UU = a 100,000-meter square.

33U UU91 = a 10,000-meter square.

33U UU9115 = a 1,000-meter square.

33U UU917155 = location to the nearest 100 meters.

33U UU91781557 = location to the nearest 10 meters.

33U UU9178515572 = location to the nearest meter.

Note!

It is beyond the scope of this manual to teach basic map reading. For further map reading information, see FM 21—26.

Chapter 2

WARSAW PACT GRID REFERENCE SYSTEM

General

The Warsaw Pact countries, like the United States and other NATO powers, have made a sustained effort since World War II to provide the best maps in preparation for any possible war. Prior to World War II, the Soviet Military Mapping Organization used the earth's measurements that had been determined in 1841 by the German scientist Bessel. A Soviet geodesist, F. N. Krasovskij, completed work to make the earth's measurements more precise in 1942, and four years later by decree of the Soviet Government, Krasovskij's refined dimensions of the earth were adopted as mandatory in determining the coordinates of geodetic points and creating maps. This decree was later expanded to all Warsaw Pact countries. It is interesting to note that Krasovskij's measurements have proved to be remarkably close to the more recent values derived from satellite geodetic methods.

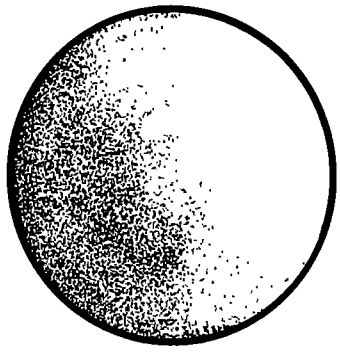


Figure 2-1. Krasovskij spheroid.

Warsaw Pact maps are based on Krasvoskij spheroid parameters which assumes mathematically that the earth's shape is closer to a true sphere (fig 2-1).

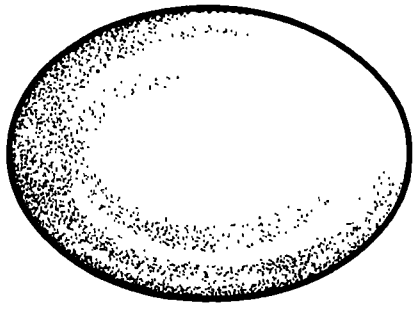


Figure 2-2. Hayford spheroid.

The Hayford spheroid, figure 2-2, depicts the earth as being somewhat flattened at the poles and consequently bulged in the area midway between the poles. Hayford's theory accounts for the resultant of two forces, gravitation and the centrifugal force of rotation.

In figure 2-3 you will note an exaggerated example of the mathematical difference between the Hayford and Krasovskij spherical concepts. Superimposing the Hayford spheroid (shaded) on the Krasovskij spheroid, you can see that the surface measurements on the Krasovskij will be different than the Hayford spheroid measurements.

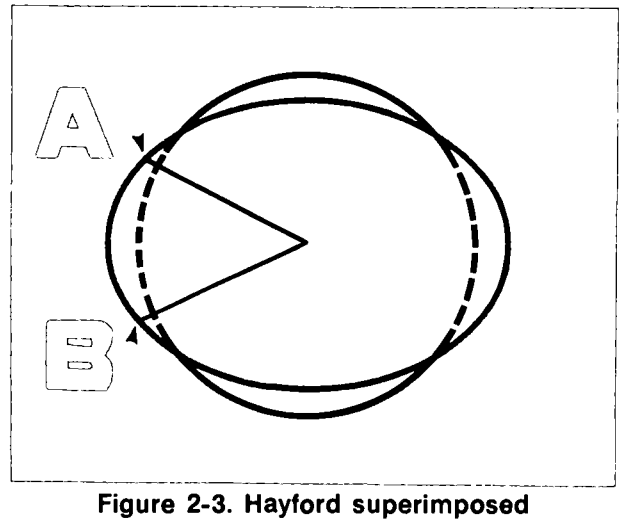
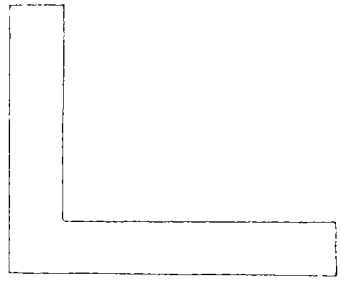
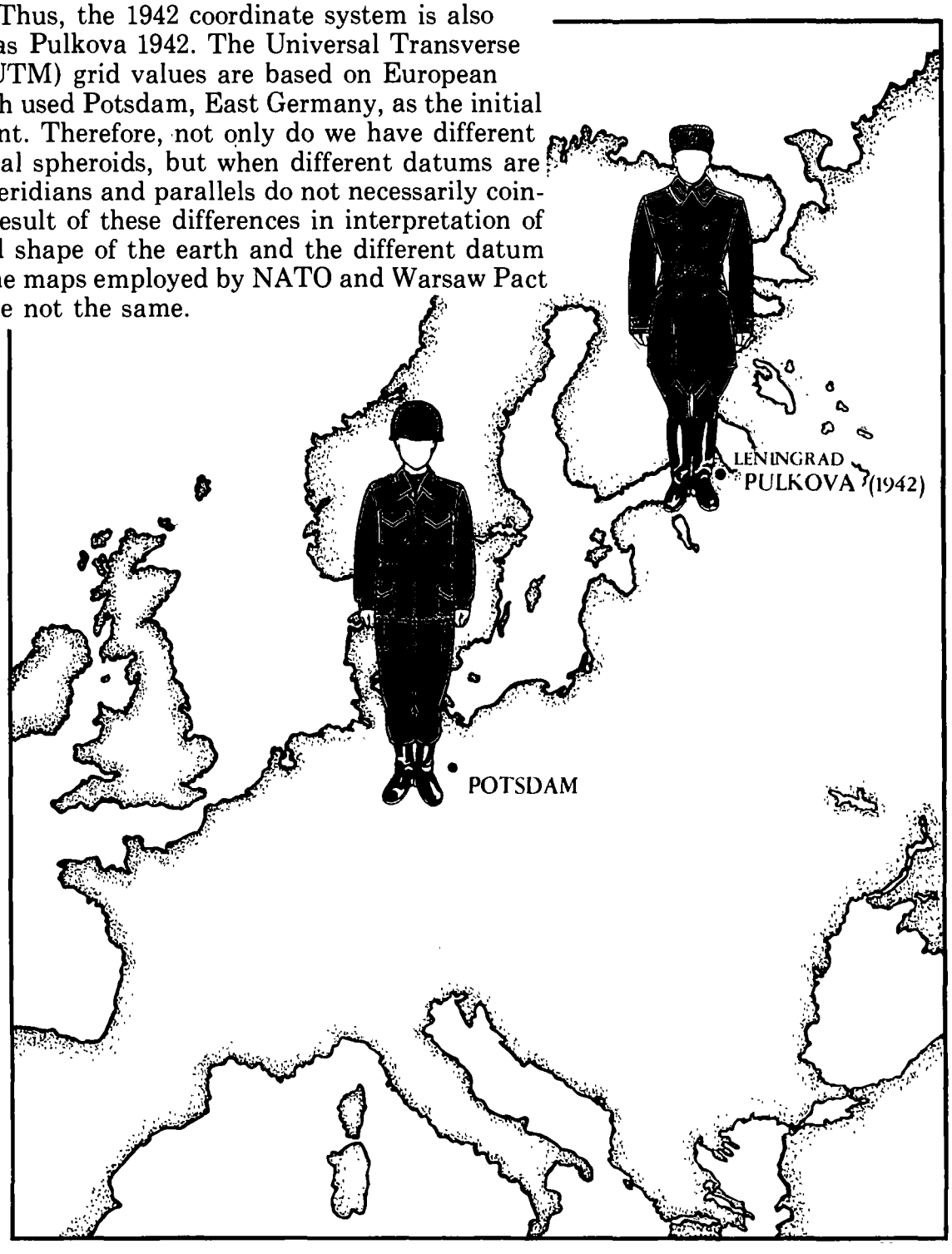


Figure 2-3. Hayford superimposed on Krasovskij spheroid.



For example, the distance measured between points A and B along the outer Hayford spheroid will be greater than the measurement between the same two points of the dotted inner line (Krasovskij).

Another significant difference between the Hayford and Krasovskij spheroids is the datum difference. Datum, in layman's terms, is simply the initial starting point or the basis for the measurement or calculation. The Gauss-Krasovskij (GK) grid values adopted as its initial point the center of the central dome of Pulkova Observatory near Leningrad. Thus, the 1942 coordinate system is also referred to as Pulkova 1942. The Universal Transverse Mercator (UTM) grid values are based on European datum which used Potsdam, East Germany, as the initial starting point. Therefore, not only do we have different mathematical spheroids, but when different datums are used, the meridians and parallels do not necessarily coincide. As a result of these differences in interpretation of the size and shape of the earth and the different datum locations, the maps employed by NATO and Warsaw Pact countries are not the same.



Projection

Warsaw Pact military maps are constructed on the transverse cylindrical Gauss-Krasovskij projection. This projection is very similar, but not identical, to the transverse Mercator projection which has been adopted by the United States and NATO since World War II. The Soviets adopted their system in 1928. At a Soviet sponsored meeting in Sophia, Bulgaria in 1952, Soviet mapping specifications were proclaimed mandatory for all Warsaw Pact countries. The Gauss-Krasovskij projection is based on 6° zones of longitude, beginning with the Greenwich Meridian and continuing around the globe in 6° increments to form a total of 60 zones, each of which extends from the North to the South pole. Each 6° zone is the basis for a projection of the points on the Krasovskij spheroid onto a cylindrical surface tangent to the central meridian of the zone. The advantage of this projection is that it reduces distortions of both distance and angle to very minimal values.

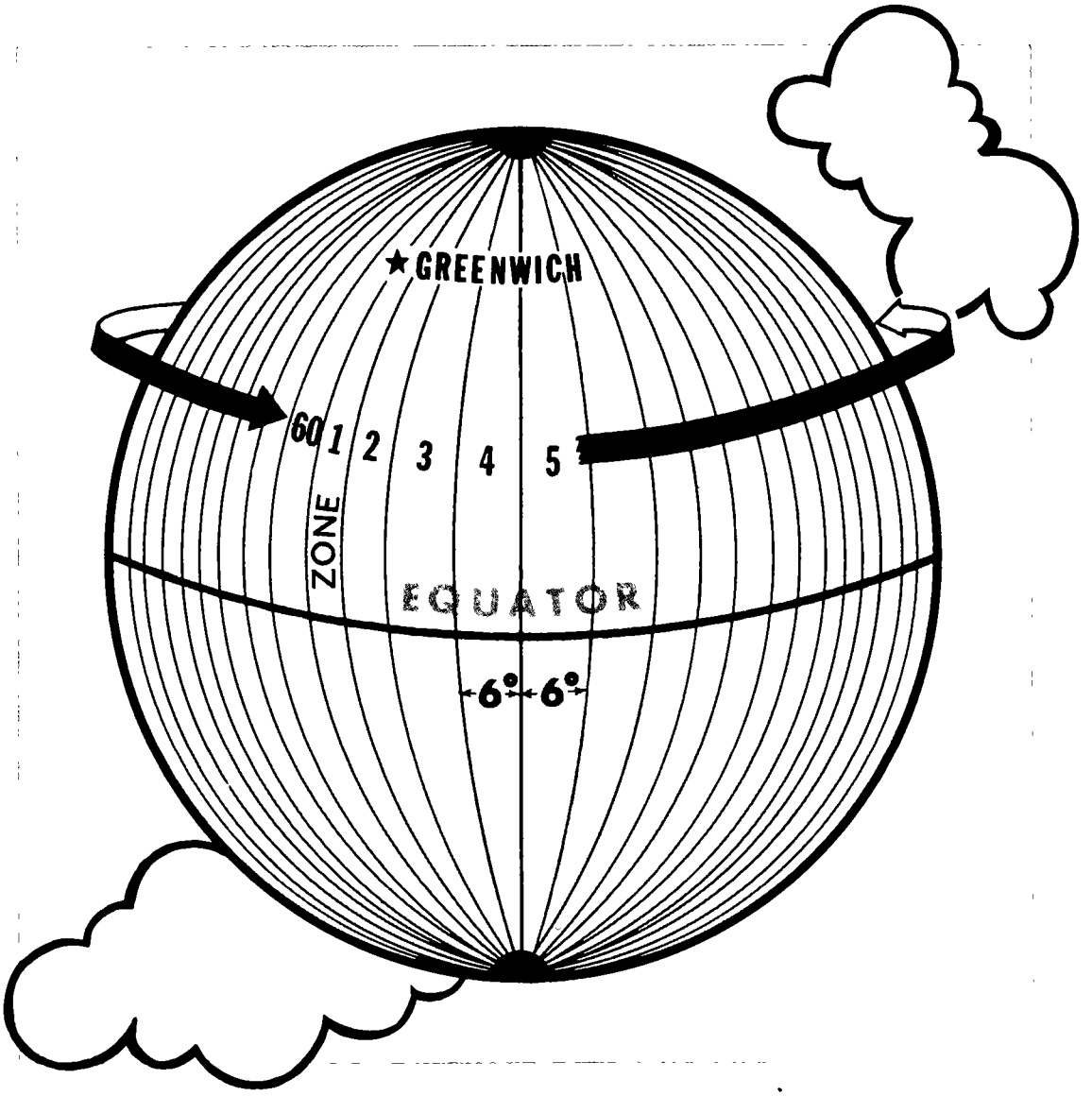


Figure 2-4. Global division of 6° Gauss-Krasovskij grid zones.

Grid System

The Gauss-Krasovskij grid system is a much simpler system in contrast to the UTM military grid system in use by NATO forces and the United States. There are 60 zones which correspond with the 6° wide bands of the Gauss-Krasovskij projection. These 6° wide zones go to the full span of the globe from the North to the South pole. There is no polar stereographic grid (fig 2-4).

Each grid zone is numbered in an easterly direction. However, where the UTM system of numbering begins at the 180th meridian, the Gauss-Krasovskij system begins at the Greenwich Meridian, exactly 30 zones apart (fig 2-5). Therefore, UTM zone number 33 will equate to the GK zone 3.

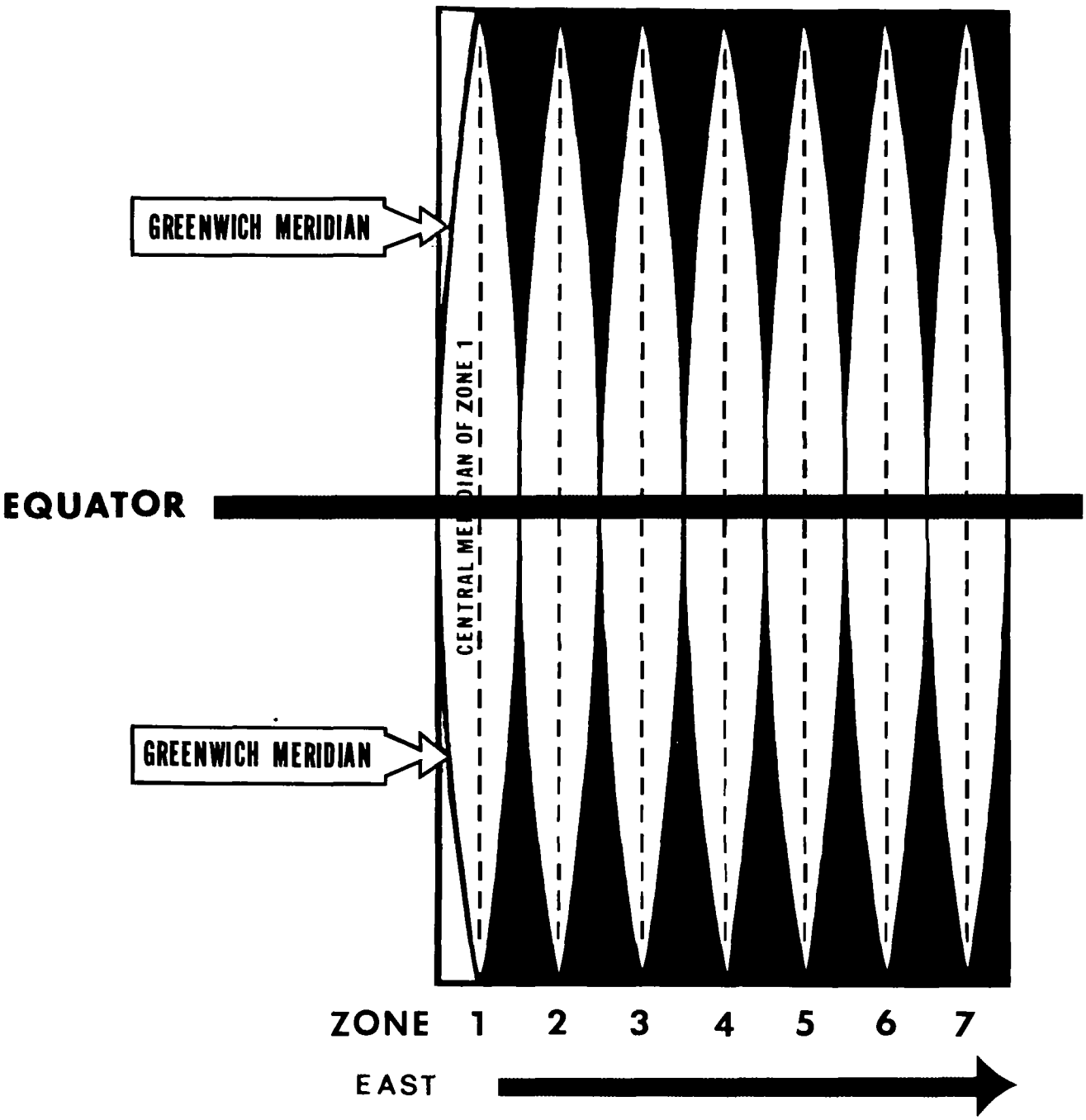


Figure 2-5. Flattened representation of 6° Gauss-Krasovskij grid zones.

Each GK 6° zone has a central meridian that divides it into east and west halves, each half being 3° of longitude. Thus, the center line of each zone (central meridian zone center) is given a value of 500,000 meters (fig 2-6). This is the zone center value (ZCV).

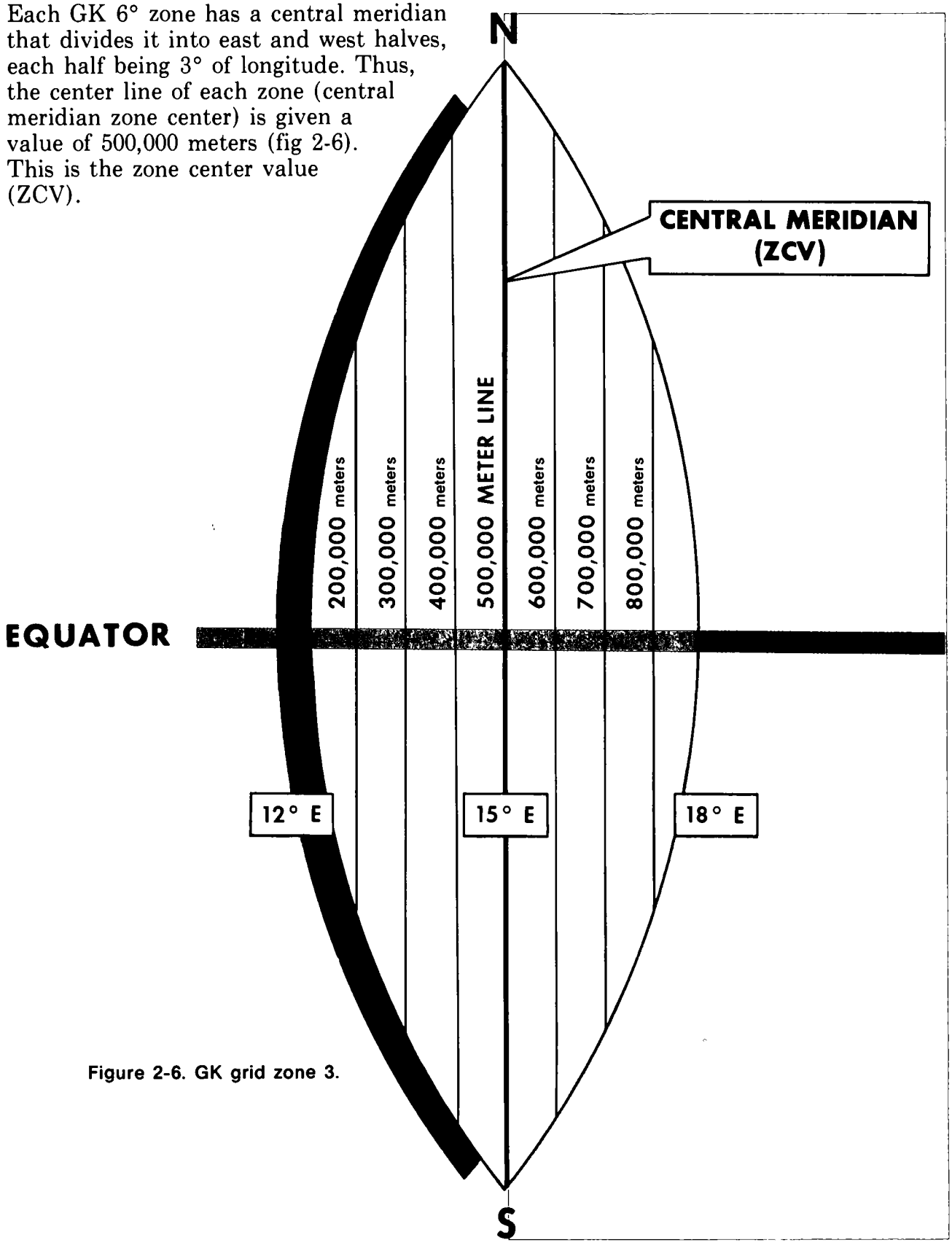


Figure 2-6. GK grid zone 3.

The 6° zone is divided into 100,000-meter subdivisions to the left and right of the ZCV. Horizontal division of the vertical grid zone is measured in meters north and south of the Equator (zero degrees). The 100,000-meter zone squares are made up of increments of 100,000-meter north-south measurements in conjunction with 100,000-meter east-west subdivisions. This subdivision is illustrated in figure 2-7.

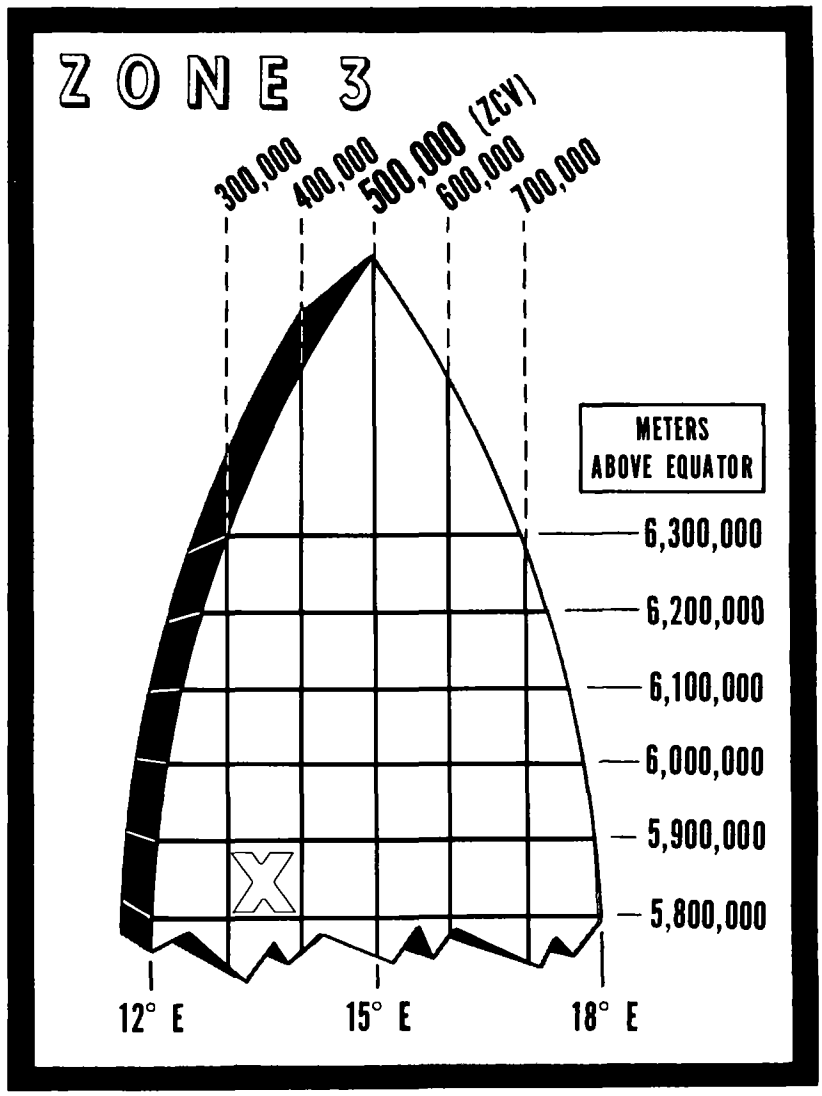
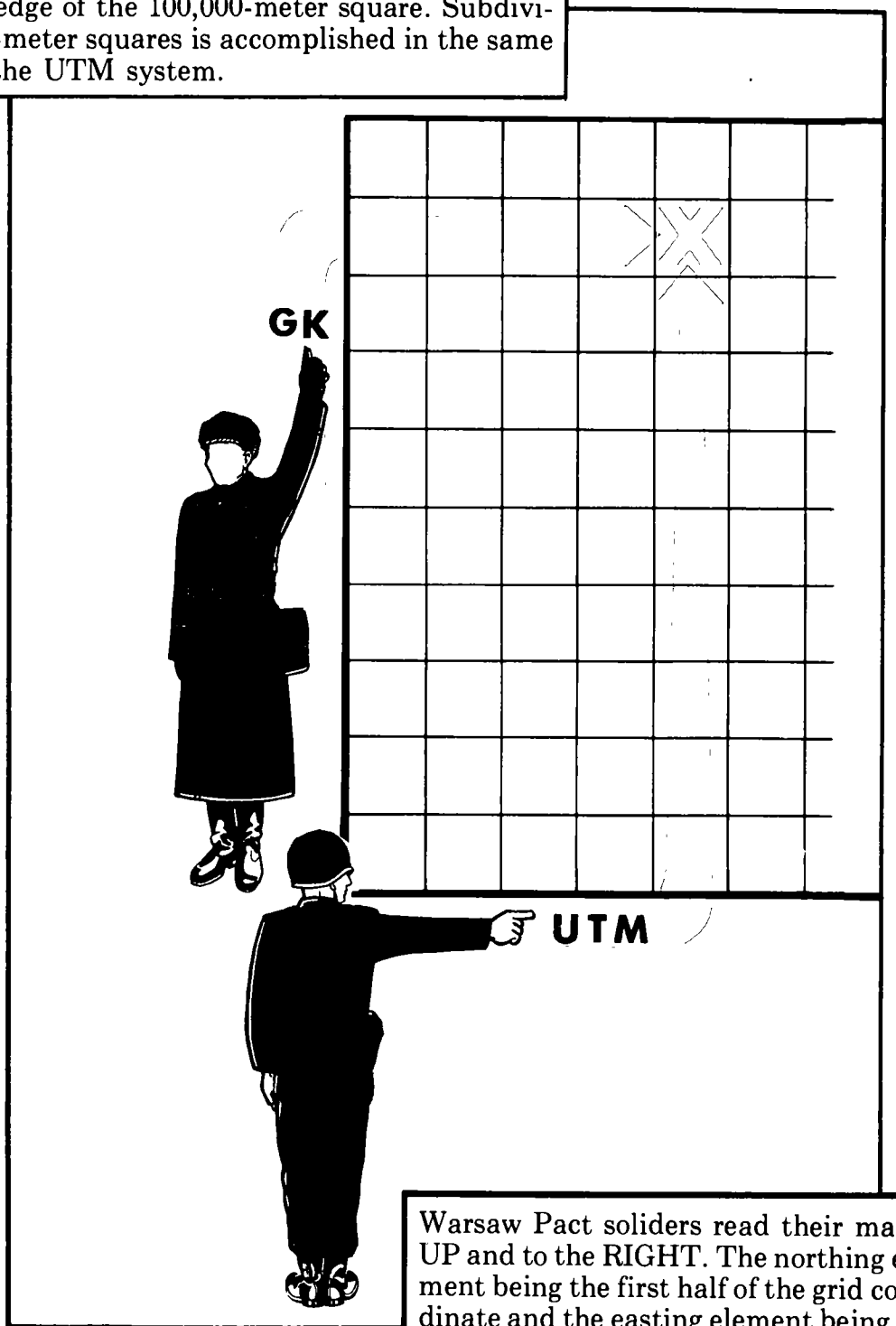


Figure 2-7. Zone 3 subdivision.

You will note the similarity to the UTM system: each 6° wide zone is divided into 100,000-meter squares. And, as in the UTM system where the two-letter digraph indicated a 100,000-meter square, the first two digits of the Gauss-Krasovskij northing and the second digit of the easting also indicate a 100,000-meter square.

All GK northing readings are taken from the zero value of the Equator. The easting readings are taken from the bottom left-hand edge of the 100,000-meter square. Subdivision of 100,000-meter squares is accomplished in the same manner as in the UTM system.

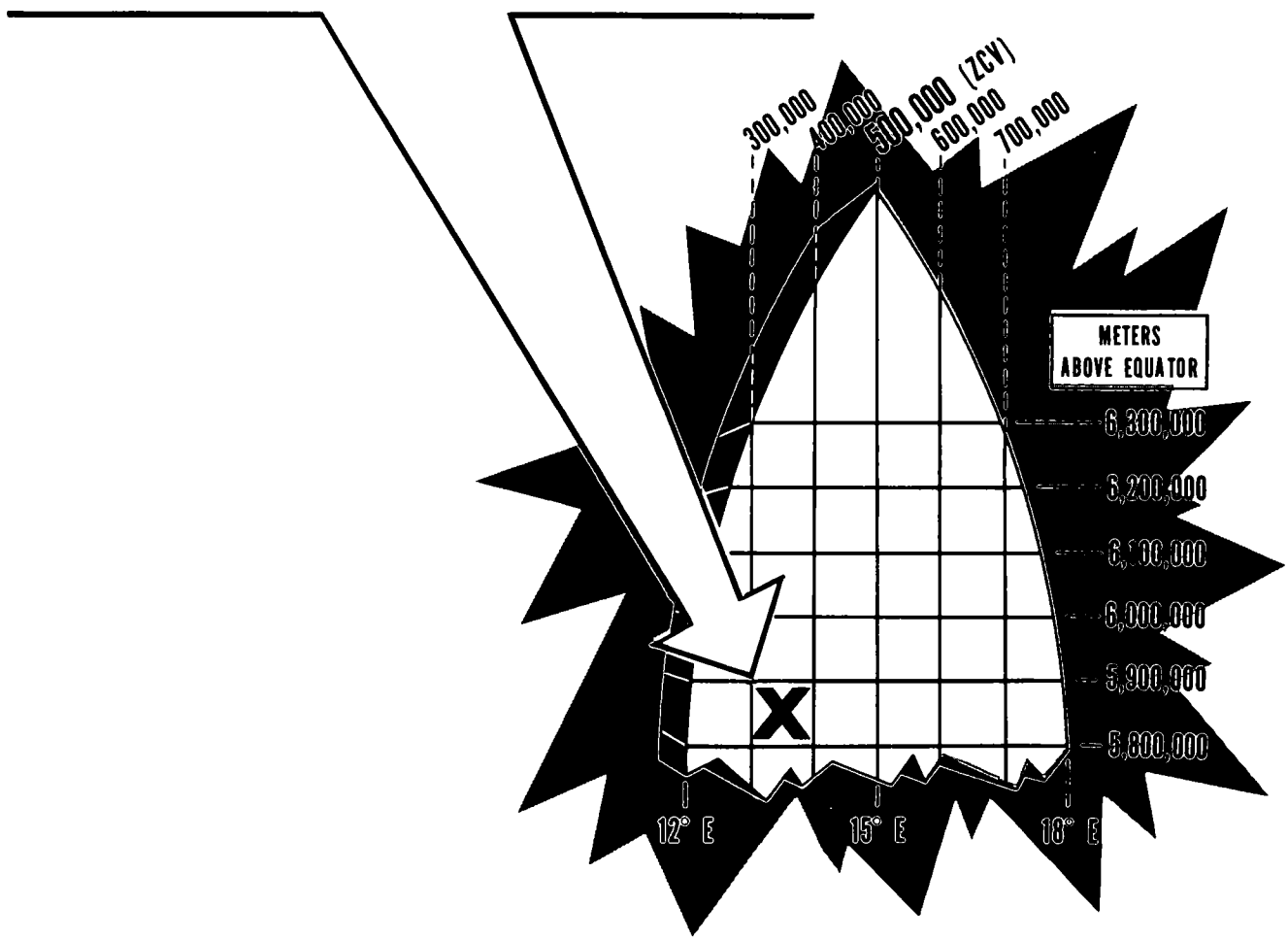


Warsaw Pact soliders read their maps UP and to the RIGHT. The northing element being the first half of the grid coordinate and the easting element being the second half. This sequence is the *reverse* of the UTM method utilized by NATO soldiers (fig 2-8).

Figure 2-8. GK and UTM comparison.

Referring to the coordinates 5832340 3372595, the GK northing element is read directly in meters. The location is 5,832,340 meters north of the Equator. **The easting element, unlike the northing, is not a total metric value.** Looking at 3372595, the first "3" is the Gauss-Krasovskij zone indicator. It indicates that the location is within the third 6° wide zone east of the Greenwich Meridian, between 12° and 18° east longitude. The second "3" indicates that the location is within the 300,000-meter block, which is west of the 500,000-meter zone center line. The remaining digits of the easting element are direct metric measurements and are read from the bottom left-hand edge of the 100,000-meter square.

Looking again at figure 2-7 and using the same Gauss-Krasovskij coordinates (5832340 3372595), you can see that the 100,000-meter block indicated by northing value 58 and easting value 33 is within the block indicated by the "X." The remainder of the coordinates may be plotted in metric measurements north and east from the bottom left-hand corner of this block.



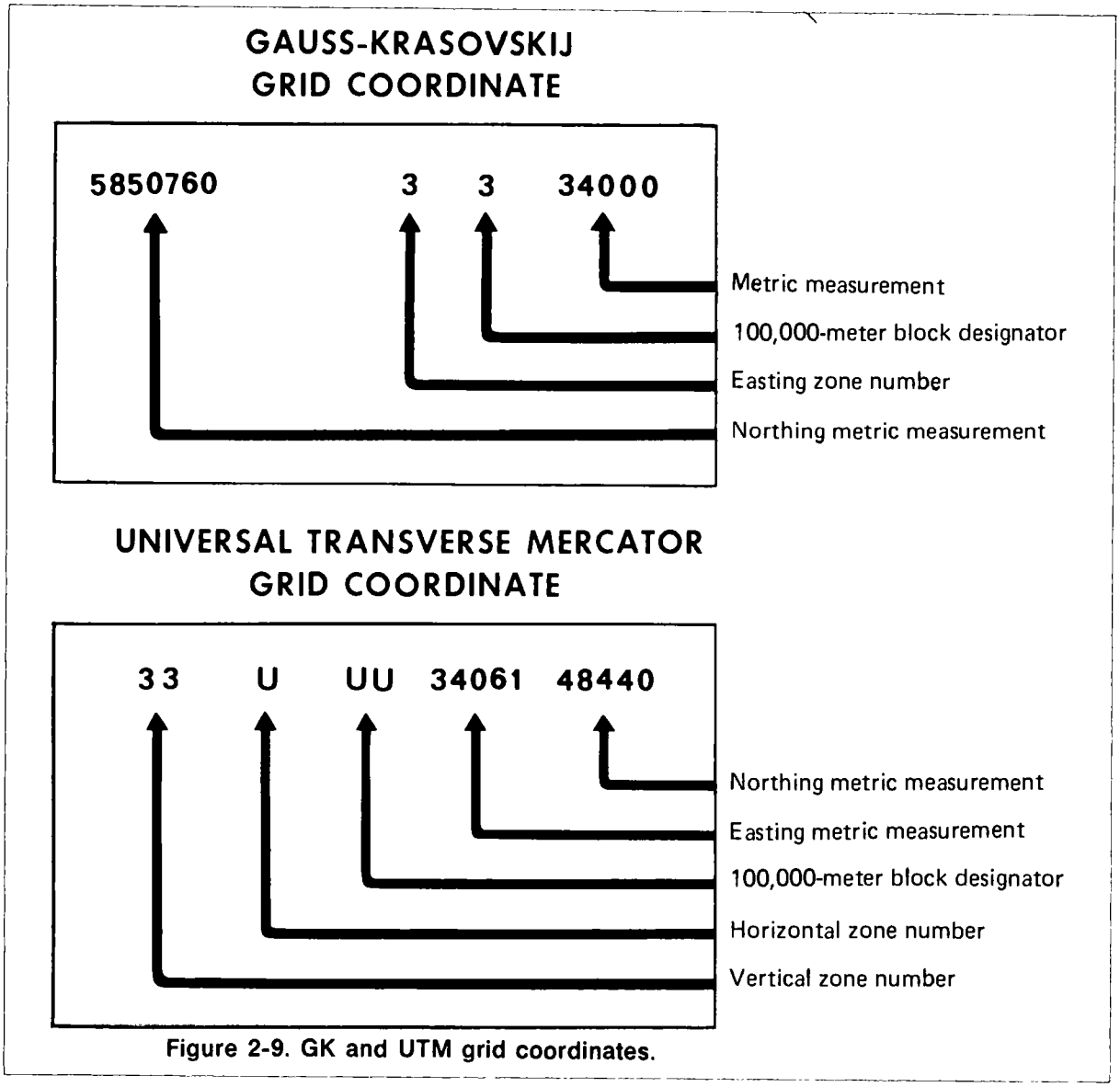


Figure 2-9. GK and UTM grid coordinates.

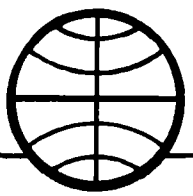
In figure 2-9, an example of a full grid coordinate reference is given to the nearest meter for the same point on the ground (a point in East Germany) in both systems: 5850760 3334000 (GK) and 33U UU 34061 (UTM).

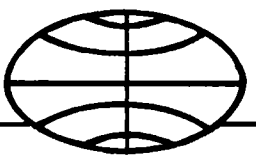
Note!

Just as in the UTM system, the fewer the digits in each element of the GK grid coordinate, the less accurate the measurement.

58	33	=	100,000-meter square
583	337	=	10,000-meter square
5832	3372	=	1,000-meter square
58323	33725	=	100-meter square
583234	337259	=	10-meter square
5832340	3372595	=	1-meter square

COMPARISON OF GK AND UTM SYSTEMS





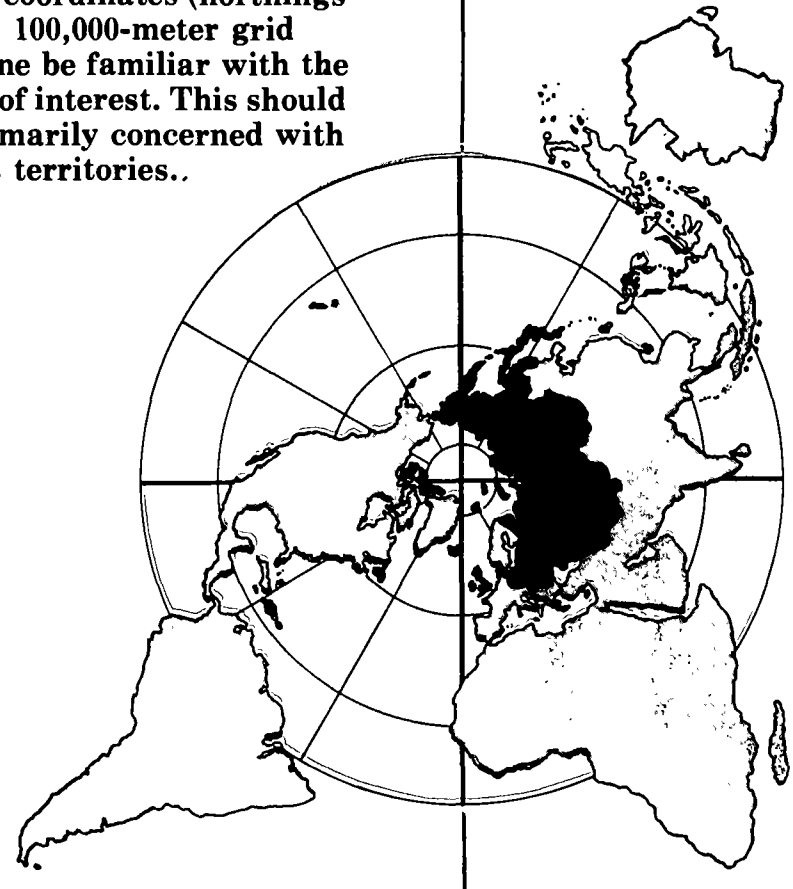
GAUSS-KRASOVSKIJ	UNIVERSAL TRANSVERSE MERCATOR MILITARY
Based on the Krasovskij concept of the earth's shape.	Based on the Hayford concept of the earth's shape.
Has 60 vertical grid zones, 6° wide, with zone number 1 beginning at the Greenwich Meridian.	Has 60 vertical grid zones, 6° wide, with zone number 1 beginning at the 180th meridian.
Divides the earth horizontally by measuring north and south of the Equator in meters, with the Equator having a value of zero meters.	Divides the earth horizontally into 20 zones of 8° high, beginning at 80° S with the letter "C" and continuing northward to 84° N latitude. The letters "I" and "O" are not used; X row is 12° high.
Designates a 100,000-meter block with four numbers (in Europe).	Designates a 100,000-meter block with two letters.
Read and write coordinates: northing portion first, easting portion second. READ: UP and RIGHT.	Read and write coordinates: easting portion first, northing portion second. READ: RIGHT and UP.
Plot easting measurements from lower left-hand corner of the 100,000-meter square. Plot northing measurements from zero meter value of the Equator.	Plot measurements from lower left-hand corner of the 100,000-meter square.

Chapter 3

CONVERSION OF GK TO UTM MILITARY GRID COORDINATES

General

Gauss-Krasovskij (GK) grid coordinates do not equate directly to Universal Transverse Mercator (UTM) military grid coordinates due to the difference in concepts of the earth's shape and the datum used in determining the Hayford and Krasovskij spheroids. Because the UTM military grid system uses digraphs to designate 100,000-meter blocks, there is no simple direct method of converting GK coordinates (northings and eastings) to UTM military 100,000-meter grid blocks. A prerequisite is that one be familiar with the map characteristics of the area of interest. This should not be a problem as we are primarily concerned with the Warsaw Pact and adjacent territories..



Charts may be constructed showing GK to UTM military grid equations, or maps may be made showing GK and UTM military grid equivalent values. Figure 3-1 is an example of a chart constructed for the East German area which depicts GK and UTM military grid equivalent values.

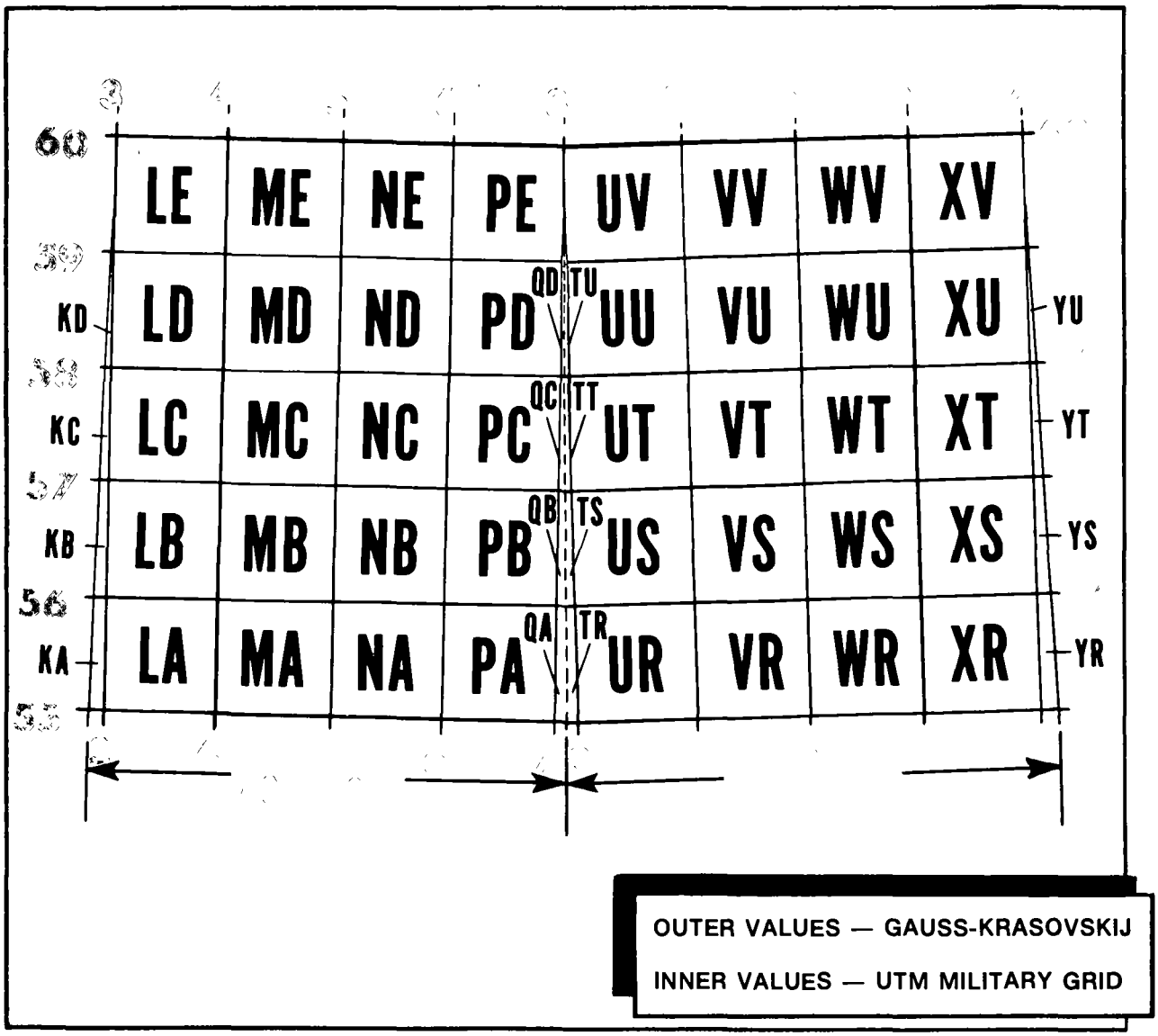
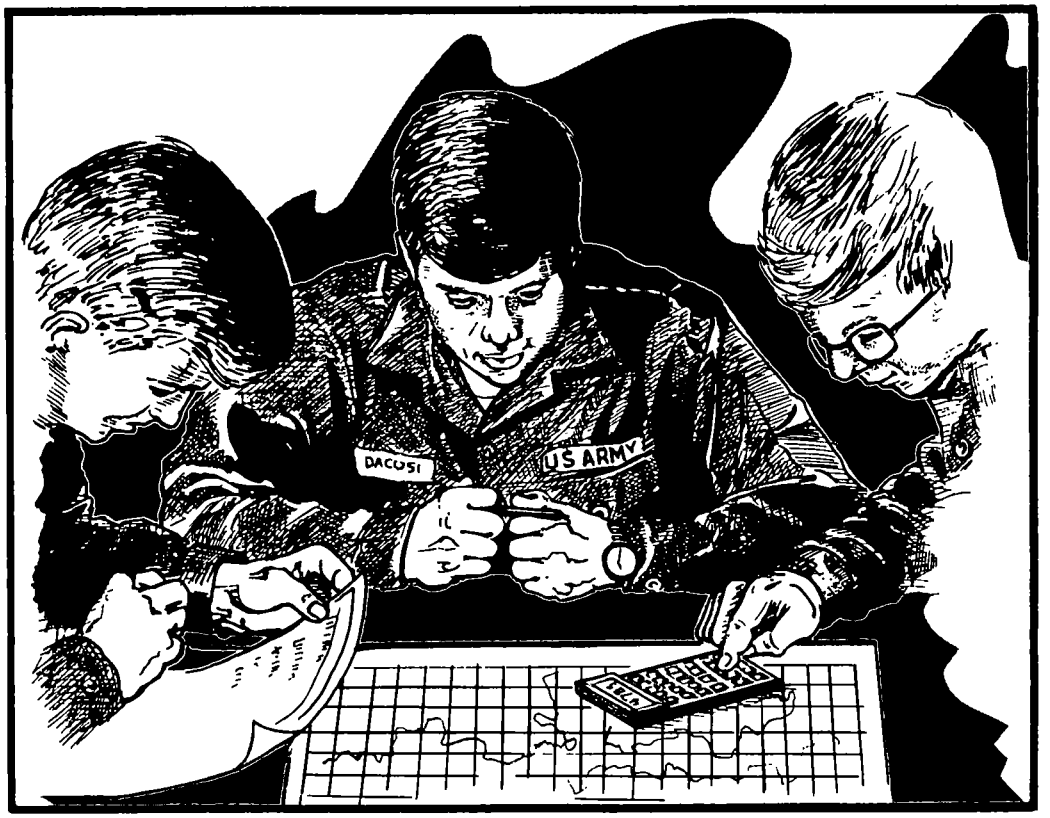

LE ME NE PE UV VV WV XV
LD MD ND PD QD TU UU VU WU XU YU
KD
LC MC NC PC QC TT UT VT WT XT YT
KC
LB MB NB PB QB TS US VS WS XS YS
KB
LA MA NA PA QA TR UR VR WR XR YR
KA
OUTER VALUES — GAUSS-KRASOVSKIJ
INNER VALUES — UTM MILITARY GRID

Figure 3-1. GK and UTM military grid map characteristics.



Calculator Method

Soldiers can quickly convert GK to UTM military grid coordinates with the use of a calculator. The GK calculator worksheet, page 3-5, is constructed so that even the relatively unskilled soldier can quickly and accurately convert GK to UTM military grid values. The worksheet is arranged for simplicity. Following steps 1 through 13, you will note that the accompanying arrows direct the proper placement and flow of information.

(Appendix H contains blank GK calculator, GK Graph and Difference Table Worksheets)!

The following zone 3 formula is used with the calculator method and will provide a conversion accuracy of *at least* plus or minus 10 meters.

ZONE 3 FORMULA

Northing or N is equal to: .9996X + 55

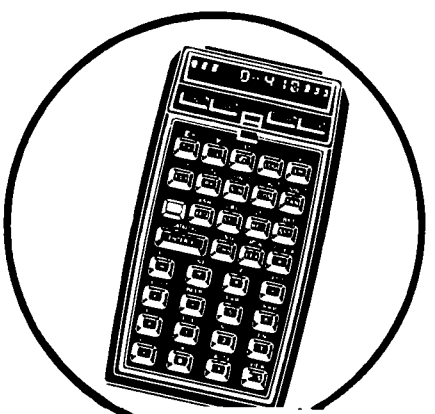
Easting or E is equal to: .9996Y + 137

Where: X = GK northing (7 digits)

Y = GK easting (7 digits)

The GK grid conversion formulas have been provided by the Defense Mapping Agency, Hydrographic/Topographic Center, Geodesy and Surveys Department, Satellite Geophysics Division, Washington, DC 20315. For instructional purposes, the formulas for zone 3 are used in explaining the calculator and graph methods of converting GK to UTM military grids.

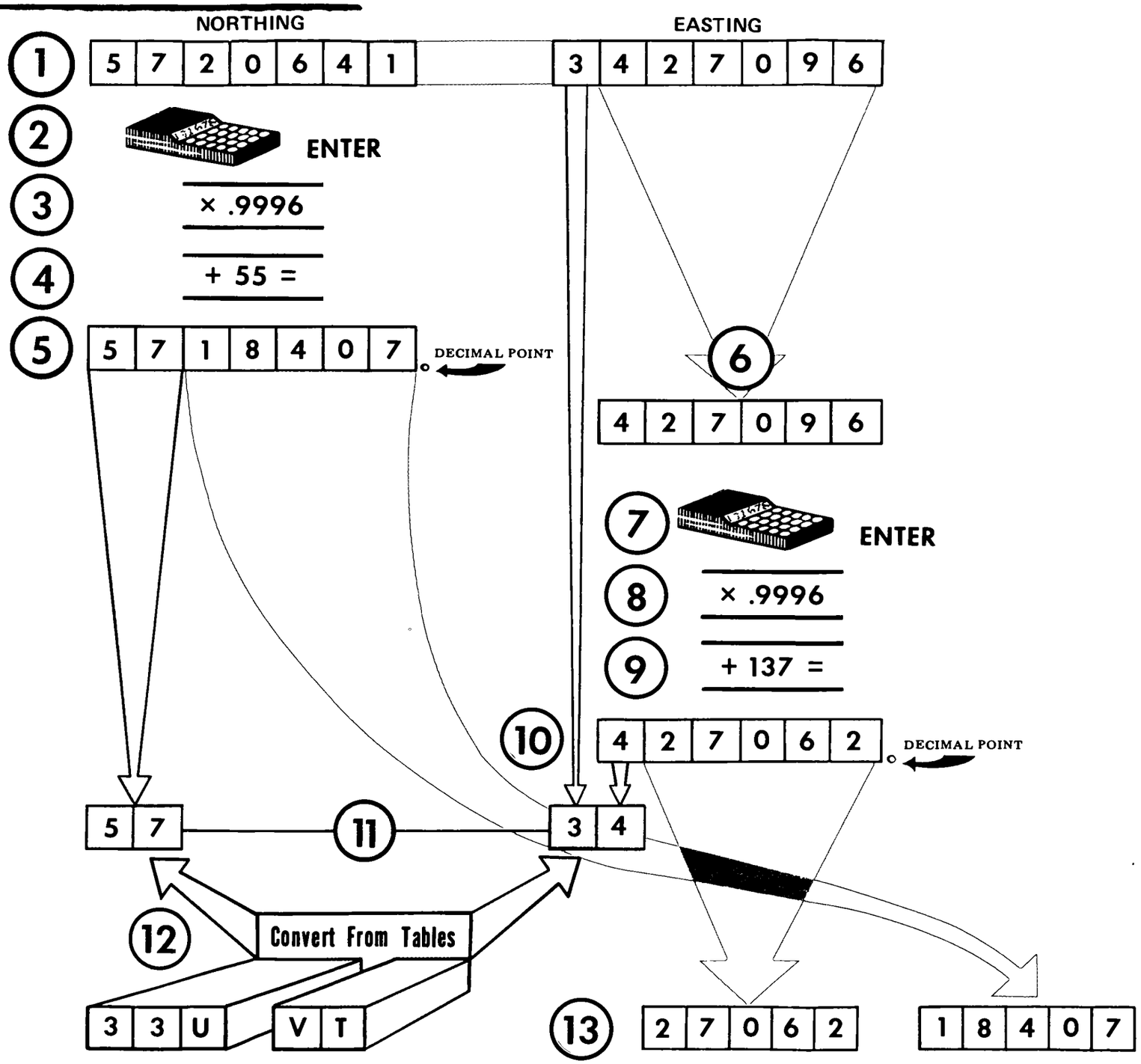
To illustrate the conversion process, we will convert the GK grid coordinates of 5720641 3427096 to UTM military grids using a hand calculator. Follow each step on the worksheet. Please note that each step is identified by a circled number that not only identifies the narrative instructions but coincides with the blocks where the information is entered on the worksheet. You also will be using the grid block conversion table which provides easy conversion from GK to UTM 100,000-meter blocks. This table is illustrated on page 3-7, and appendix E contains zone 1 thru 5 conversion tables. To use the table, simply locate the appropriate GK grid block and the corresponding UTM military grid block that appears to the right of the equal sign. For example, GK grid 60 24 equates to UTM 32U MF.



It is recommended that you use your calculator at this point and perform steps 1 thru 13 on the calculator worksheet.

NOTE! **Zone 3 Formulas are used in this example.**

1. RECORD **GK** GRID IN BLOCKS AT RIGHT.
2. ENTER NORTHING IN CALCULATOR.
3. MULTIPLY BY .9996
4. ADD 55.
5. RECORD DIGITS TO LEFT OF DECIMAL POINT. OMIT DIGITS AFTER DECIMAL POINT.
6. COPY LAST 6 DIGITS FROM STEP **1** EASTING AND ENTER AT FAR RIGHT AS SHOWN BY ARROW.
7. ENTER IN CALCULATOR.
8. MULTIPLY BY .9996.
9. ADD 137.
10. RECORD DIGITS TO LEFT OF DECIMAL POINTS.
11. COPY DIGITS FROM STEPS **5, 1,** AND **10** AS SHOWN BY ARROWS.
12. CONVERT TO UTM USING THE BLOCK CONVERSION TABLES (PAGE 3-7).
13. COPY LAST 5 DIGITS FROM STEPS **5** AND **10** AS SHOWN BY ARROWS.



STEPS 12 AND 13 ARE THE UTM MILITARY GRID

INSTRUCTIONS:

Locate the GK grid block on left using digits from number 11 calculator worksheet, or the number 7 graph worksheet. The corresponding UTM military grid block appears to the right of the equal sign. Record the UTM military grid block in the number 12 information blocks of the calculator worksheet, or the number 8 information blocks of the graph worksheet.

GRID BLOCK CONVERSION

GK	UTM	GK	UTM
60 24	= 32U MF	57 25	= 32U NC
60 25	= 32U NF	57 26	= 32U PC
60 26	= 32U PF	57 27	= 32U QC
60 33	= 33U UA	57 32	= 32U TT
60 34	= 33U VA	57 33	= 33U UT
60 35	= 33U WA	57 34	= 33U VT
59 24	= 32U ME	57 35	= 33U WT
59 25	= 32U NE	56 24	= 32U MB
59 26	= 32U PE	56 25	= 32U NB
59 27	= 32U QE	56 26	= 32U PB
59 32	= 33U TV	56 27	= 33U QB
59 34	= 33U VV	56 32	= 33U TS
59 35	= 33U WV	56 33	= 33U US
58 24	= 33U MD	56 34	= 33U VS
58 25	= 32U ND	56 35	= 33U WS
58 26	= 32U PD	55 24	= 32U MA
58 27	= 32U QD	55 25	= 32U NA
58 32	= 33U TU	55 26	= 32U PA
58 33	= 33U UU	55 27	= 32U QA
58 34	= 33U VU	55 32	= 33U TR
58 35	= 33U WU	55 33	= 33U UR
57 24	= 32U MC	55 34	= 33U VR
		55 35	= 33U WR

As you can see, the GK grid coordinates of 5720641 3427096 convert to 33U VT 27062 18407. Please remember that the formula has a conversion accuracy of at least plus or minus 10 meters. Additionally, step 13 is a result of the GK reading UP (northing) and RIGHT (easting), whereas the UTM military grid reads RIGHT (east) and UP (north).

Graph Method

Another method is the graph or manual conversion process. Using the same GK coordinates as used in the calculator illustration, 5720641 3427096, we will work through the conversion process. The GK graph worksheet, page 3-11, is arranged for simplicity. Following steps 1 through 9, you will note that the accompanying arrows direct the proper placement and flow of information. Each step is identified by a circled number which identifies the narrative instructions and coincides with the appropriate information blocks.

The following zone 3 formula is used with the graph method and will provide a conversion accuracy of at least plus or minus 10 meters.

ZONE 3 FORMULA

Northing or N is equal to: $X - \Delta X$

Easting or E is equal to: $Y + \Delta Y$

Where:
X = GK northing (7 digits)
ΔX = northing difference from graph
Y = GK easting (6 digits)
ΔY = easting difference from graph

Note!

You must determine a northing difference (Δ X) and an easting difference (Δ Y). The following example is provided to assist in reading the northing and easting graphs.

To find the northing difference (Δ X) of the GK northing grid 5720641:

1 **Locate the approximate position of 5720641 on the (X) side of the northing graph (fig 3-2).**

2 **From 5720641, read straight across to the diagonal line.**

3 **From the diagonal line, read down to the Δ X side of the northing graph. You should find approximately 2236.**

This value would then be recorded in the (2) blocks of your GK graph worksheet. The easting graph also is read in a similar manner.

Go to the GK graph worksheet, page 3-11, and follow steps 1 through 9.

NORTHING GRAPH

[redacted] N = X − ΔX [redacted]

[redacted]GK ZONE 3[redacted]

42°00′ to 54°00′
North Latitude

12°00′ to 18°00′
East Longitude

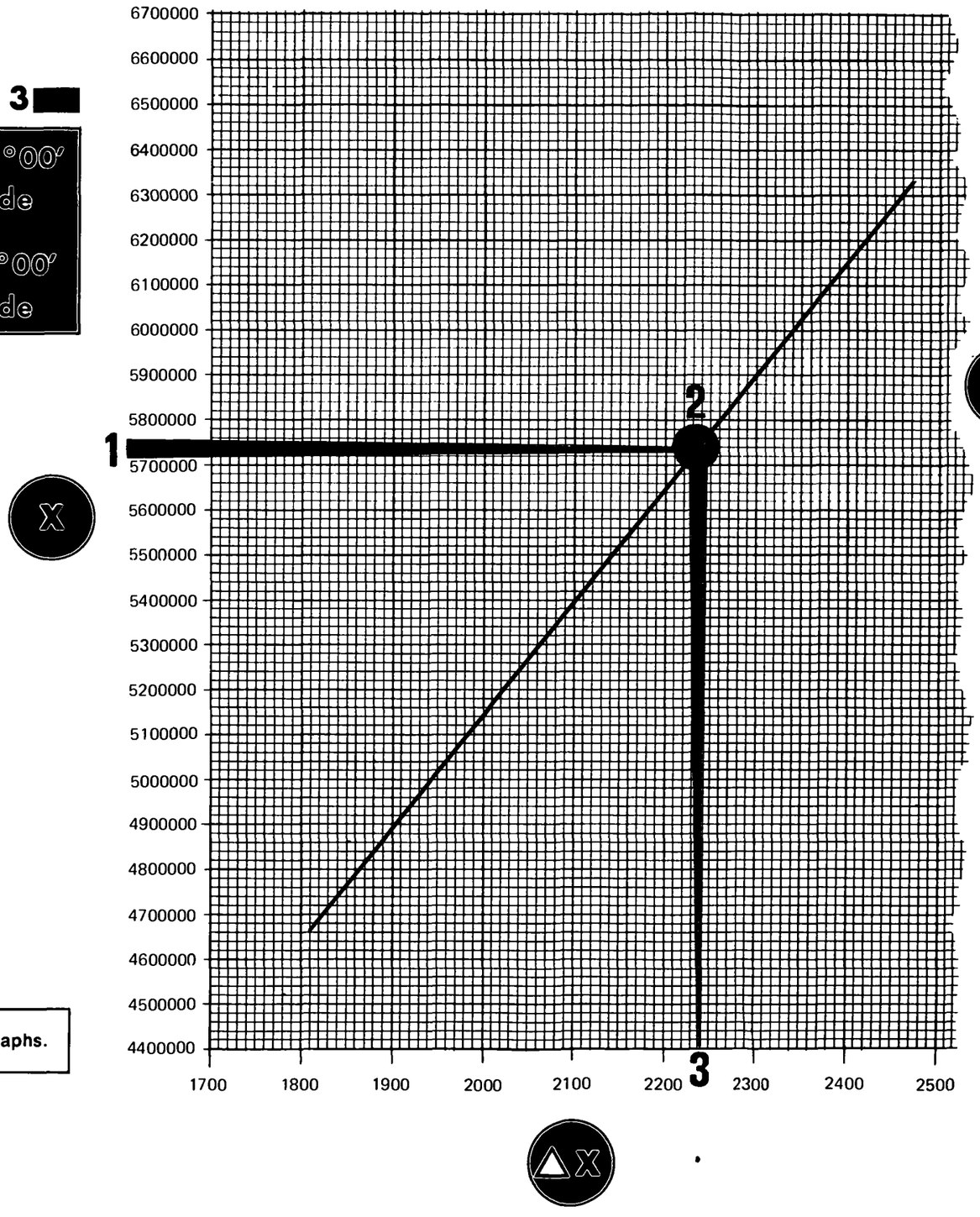
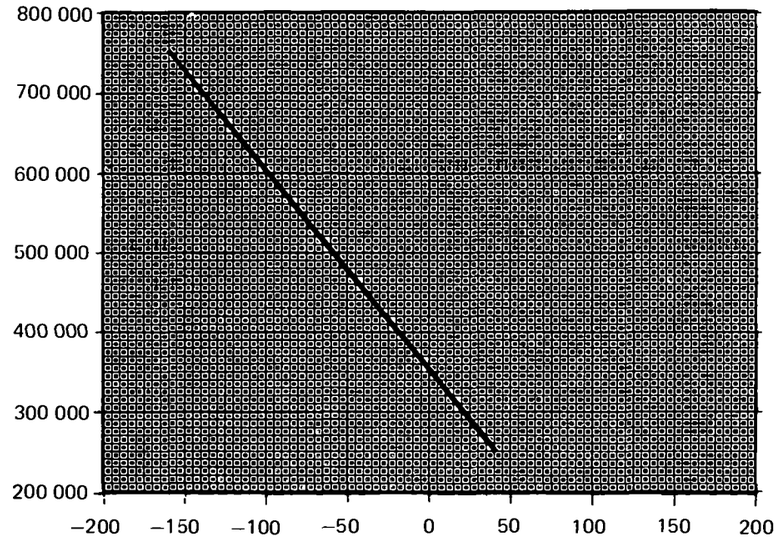


Figure 3-2.
Northing and Easting Graphs.

EASTING GRAPH

[redacted] E = Y + ΔY [redacted]



ZONE 3 FORMULA

NORTHING OR N IS EQUAL TO: **X − ΔX**

EASTING OR E IS EQUAL TO: **Y + ΔY**

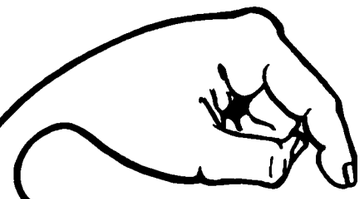
WHERE:

X = GK NORTHING (7 DIGITS)

ΔX = NORTHING DIFFERENCE FROM GRAPH

Y = GK EASTING (6 DIGITS)

ΔY = EASTING DIFFERENCE FROM GRAPH



Please note that there could be a slight variation between the calculator and graph methods. If you compare the UTM grid coordinates that were obtained by the calculator conversion (page 3-5) with the graph conversion (page 3-11), you will see there is a difference of 1 meter northing and 2 meters easting. This difference is due to individual interpretation of the graph itself but is reasonably close to the calculator method and will provide adequate accuracy.

GK GRAPH WORKSHEET

1. RECORD GK GRID IN BLOCKS AT RIGHT.

2. FIND THE NORTHING DIFFERENCE (ΔX). READ FROM **GK** NORTHING GRID ACROSS TO DIAGONAL LINE ON CHART. THEN READ DOWN TO FIND THE CORRESPONDING VALUE FOR ΔX. ENTER ΔX IN THE ② BLOCKS.

3. SUBTRACT ΔX FROM STEP **1** AND ENTER HERE.

4. COPY LAST 6 DIGITS FROM STEP **1** EASTING AND ENTER AT FAR RIGHT AS SHOWN BY ARROW.

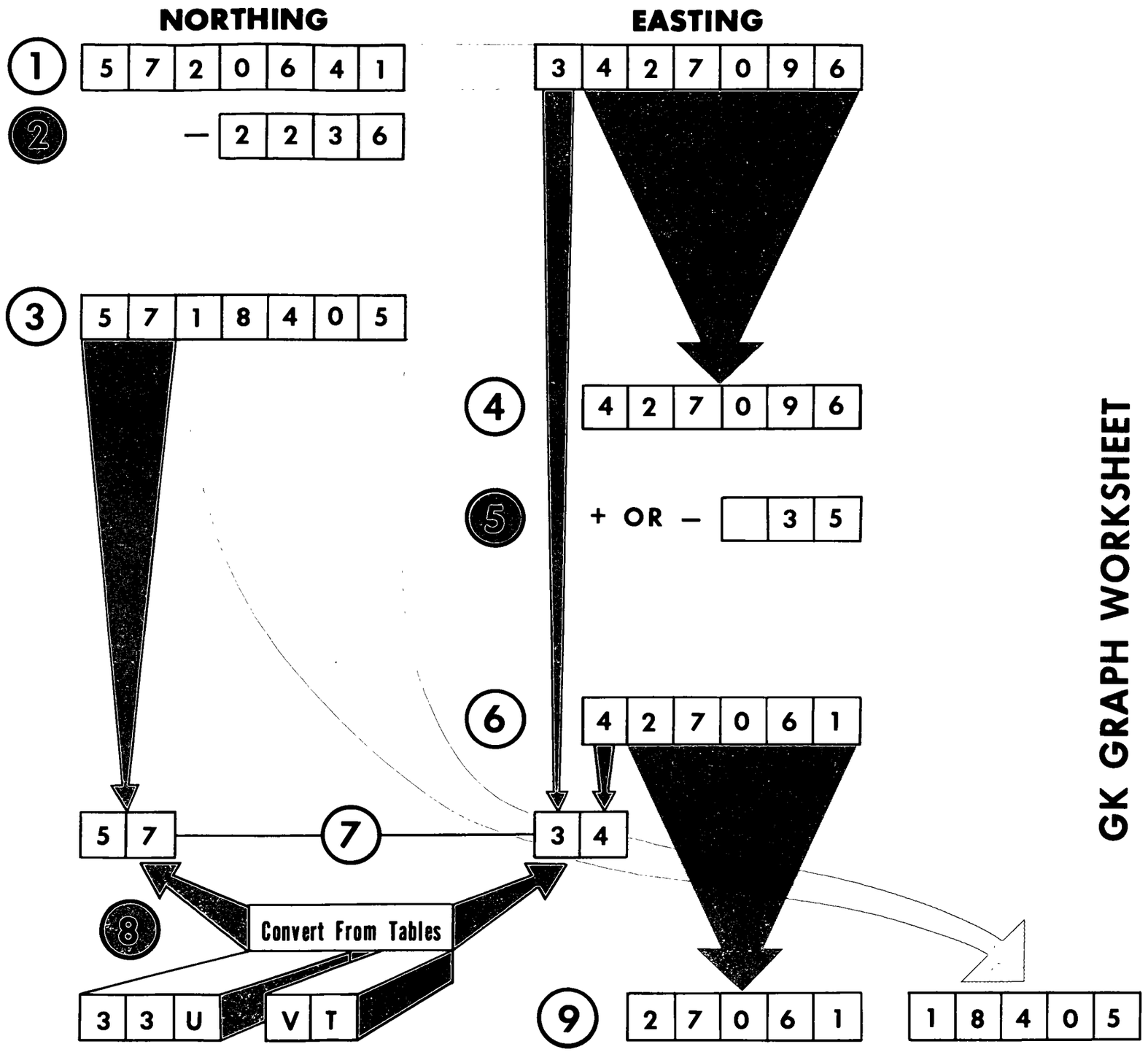
5. FIND THE EASTING DIFFERENCE (ΔY). GO TO EASTING GRAPH. READ FROM **GK** EASTING GRID ACROSS TO DIAGONAL LINE ON THE GRAPH. READ DOWN TO FIND THE CORRESPONDING VALUE FOR ΔY. ENTER ΔY IN THE ⑤ BLOCKS.

6. IF THE ΔY VALUE IS POSITIVE, *ADD* TO STEP **1**. IF THE ΔY VALUE IS **NEGATIVE**, *SUBTRACT* FROM STEP **1**.

7. COPY DIGITS FROM STEPS **3, 1,** AND **6** AS SHOWN BY ARROWS.

8. CONVERT TO **UTM** USING THE BLOCK CONVERSION TABLES (PAGE 3–7).

9. COPY LAST 5 DIGITS FROM STEPS **3** AND **6** AS SHOWN BY ARROWS.



STEPS 8 AND 9 ARE THE UTM MILITARY GRID

Difference Tables Method

One of the easier methods of converting GK to UTM military grid coordinates is by using the northing and easting difference tabes. The northing and easting difference tables are found in appendix D and are illustrated in figure 3-3. The tables are machine generated and will provide accuracy to within plus or minus 10 meters. Looking at figure 3-3, you will note that the major GK northing appears at the top of the page. Each page is further divided into major sections: the GK NORTHING (X) and the DELTA X (Δ X) or difference. The GK NORTHING (X), as illustrated in figure 3-3, is based on 5,700,000 meters with an interval of 2499 meters between left and right columns. The DELTA X (Δ X) columns provide differences for zones 1 thru 5 and are directly adjacent to the GK NORTHING (X).

GK NORTHING 5700000

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
5698751 - 5701250	2233	2228	2225	2219	2213
5701251 - 5703750	2234	2229	2226	2220	2214
5703751 - 5706250	2235	2230	2227	2221	2215
5706251 - 5708750	2236	2231	2228	2222	2216
5708751 - 5711250	2237	2232	2229	2223	2217
5711251 - 5713750	2238	2233	2230	2224	2218
5713751 - 5716250	2239	2234	2231	2225	2219
5716251 - 5718750	2240	2235	2232	2226	2220
5718751 - 5721250	2241	2236	2233	2227	2221
5721251 - 5723750	2242	2237	2234	2228	2222
5723751 - 5726250	2243	2238	2235	2229	2223
5726251 - 5728750	2244	2239	2236	2230	2224
5728751 - 5731250	2245	2240	2237	2231	2225
5731251 - 5733750	2246	2241	2238	2232	2226
5733751 - 5736250	2247	2242	2239	2233	2227
5736251 - 5738750	2248	2243	2240	2234	2228
5738751 - 5741250	2249	2244	2241	2235	2229
5741251 - 5743750	2250	2245	2242	2238	2230
5743751 - 5746250	2251	2246	2243	2237	2231
5746251 - 5748750	2252	2247	2244	2238	2232
5748751 - 5751250	2253	2248	2245	2239	2233
5751251 - 5753750	2254	2249	2246	2240	2234
5753751 - 5756250	2255	2250	2247	2241	2235
5756251 - 5758750	2256	2251	2248	2242	2236
5758751 - 5761250	2257	2252	2249	2243	2237
5761251 - 5763750	2258	2253	2250	2244	2238
5763751 - 5766250	2259	2254	2251	2245	2239
5766251 - 5768750	2260	2255	2252	2246	2240
5768751 - 5771250	2261	2256	2253	2247	2241
5771251 - 5773750	2262	2257	2254	2248	2242
5773751 - 5776250	2263	2258	2255	2249	2243
5776251 - 5778750	2264	2259	2256	2250	2244
5778751 - 5781250	2265	2260	2257	2251	2245
5781251 - 5783750	2266	2261	2258	2252	2246
5783751 - 5786250	2267	2262	2259	2253	2247
5786251 - 5788750	2268	2263	2260	2254	2248
5788751 - 5791250	2269	2264	2261	2255	2249
5791251 - 5793750	2270	2265	2262	2256	2250
5793751 - 5796250	2271	2266	2263	2257	2251
5796251 - 5798750	2272	2267	2264	2258	2252
5798751 - 5801250	2273	2268	2265	2259	2253

Figure 3-3. GK Northing Difference Table for 5700000.

To use the GK northing difference table, first locate the appropriate GK NORTHING (X) line. For example, if the GK northing is 5745125, proceed down the GK NORTHING columns until you locate "5743751 - 5746250" as indicated by the arrow in fig 3-3. Since 5745125 is located within the 2499 meter spread from 5743751 - 5746250, this is the correct line to use. Next, follow the line across until you locate the appropriate zone. If for example, you wanted to determine the northing difference for zone 3, the DELTA X (Δ X) difference would be 2243.

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
5698751 - 5701250	2233	2228	2225	2219	2213
5701251 - 5703750	2234	2229	2226	2220	2214
5738751 - 5741250	2249	2244	2241	2235	2229
5741251 - 5743750	2250	2245	2242	2236	2230
5743751 - 5746250	2251	2246	2243	2237	2231
5746251 - 5748750	2252	2247	2244	2238	2232

This numerical difference is then entered in the ② blocks of the worksheet. The easting tables are constructed and read in a similar manner; however, you will note the first digit or zone indicator is removed.

GK EASTING (Y)	DELTA Y (Δ Y)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
398751 - 401250	-3	-13	-23	-31	-40
401251 - 403750	-4	-14	-24	-32	-41
403751 - 406250	-5	-15	-25	-33	-42
423751 - 426250	-13	-23	-33	-41	-50
426251 - 428750	-14	-24	-34	-42	-51
428751 - 431250	-15	-25	-35	-43	-52
431251 - 433750	-16	-26	-36		

Using the same GK, coordinates as used in the calculator and graph illustrations, 5720641 3427096, we will work through the difference tables conversion method. Go to the difference table worksheet, page 3-14, and using the northing and easting difference tables in appendix D, follow steps 1 through 9.

DIFFERENCE TABLE WORKSHEET

1. RECORD GK GRID IN BLOCKS AT RIGHT.

2. FIND THE NORTHING DIFFERENCE (ΔX). DETERMINE THE APPROPRIATE **GK NORTHING (X)** NUMERICAL SPREAD. READ ACROSS TO THE **DELTA X** (ΔX) AND FIND THE DESIRED ZONE (INDICATED BY THE FIRST NUMBER IN THE GK EASTING). DETERMINE ΔX AND ENTER IN THE ② BLOCKS.

3. SUBTRACT ΔX FROM STEP **1** AND ENTER HERE.

4. COPY LAST 6 DIGITS FROM STEP **1** EASTING AND ENTER AT FAR RIGHT AS SHOWN BY ARROW.

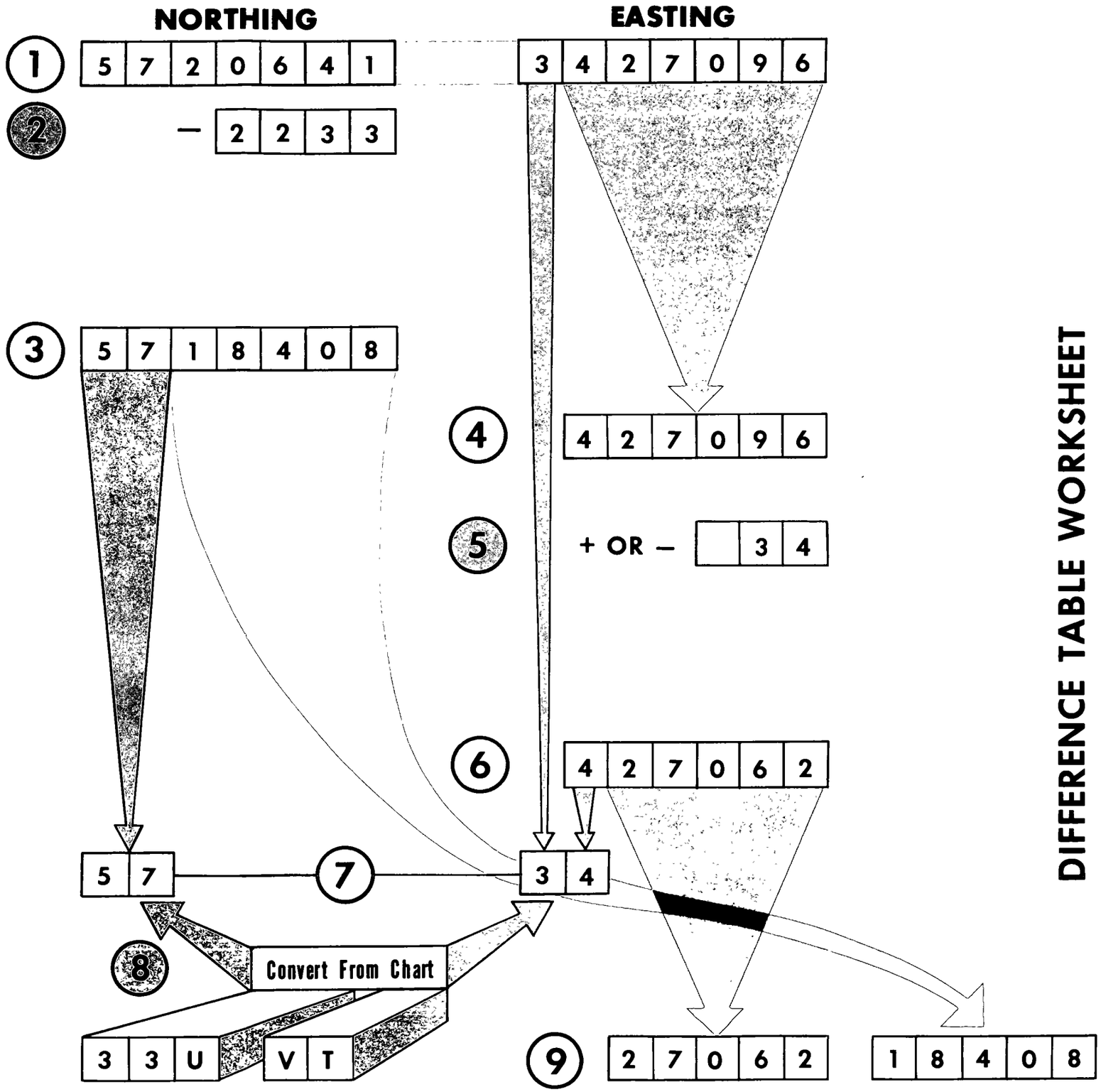
5. FIND THE EASTING DIFFERENCE (ΔY). GO TO THE GK EASTING DIFFERENCE TABLES. DETERMINE THE APPROPRIATE **GK EASTING (Y)** NUMERICAL SPREAD. READ ACROSS TO THE **DELTA Y** (ΔY) AND FIND THE DESIRED ZONE. DETERMINE ΔY AND ENTER IN THE ⑤ BLOCKS.

6. IF THE ΔY VALUE IS POSITIVE, *ADD* TO STEP **1**. IF THE ΔY VALUE IS NEGATIVE, *SUBTRACT* FROM STEP **1**.

7. COPY DIGITS FROM STEPS **3, 1,** AND **6** AS SHOWN BY THE ARROWS.

8. CONVERT TO UTM USING THE BLOCK COVERSION TABLES (PAGE 3-7).

9. COPY LAST 5 DIGITS FROM STEPS **3** AND **6** AS SHOWN BY ARROWS.



STEPS 8 AND 9 ARE THE UTM MILITARY GRID

Working Aids

To facilitate field requirements, the following supporting material is provided as appendixes to this FM:

Appendix B	Warsaw Pact Map. This is a map foldout of the Warsaw Pact area and adjacent territories.
Appendix C	Northing and Easting Graphs. Provides northing and easting graphs for GK zones 1 through 5.
Appendix D	Northing and Easting Difference Tables. Provides northing and easting differences for the Warsaw Pact area and adjacent territories.
Appendix E	Grid Block Conversion Tables. These tables are for GK-to-UTM grid block conversion for GK zones 1 through 5.
Appendix F	Conversion Formulas. The formulas are provided by the Defense Mapping Agency (DMA) for GK zones 1 through 5 to convert GK to UTM military coordinates.
Appendix G	Tables of Trigonometric Functions SINE, COSINE for Angles in Degrees and Decimals. The natural trigonometric functions table gives the values of the SINE and COSINE for each tenth of a degree from 0 to 359.
Appendix H	Worksheets. Blank calculator, graph, and difference table worksheets may be locally reproduced for field use.

Chapter 4

PROJECTED GK GRIDS

General

Both the Universal Transverse Mercator (UTM) military and the Gauss-Krasovskij (GK) grid systems divide the world into 60 zones. Each GK zone is elongated or cigar shaped and is 6° of longitude with both extremities converging at the poles (fig 4-1).

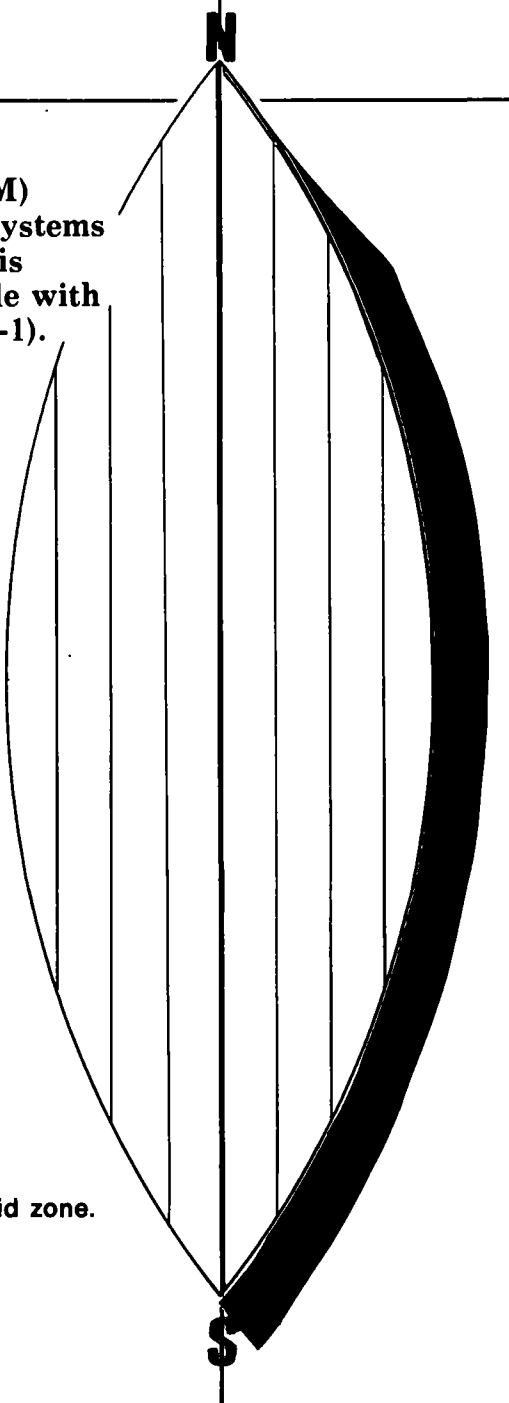


Figure 4-1. N-S diagram of GK grid zone.

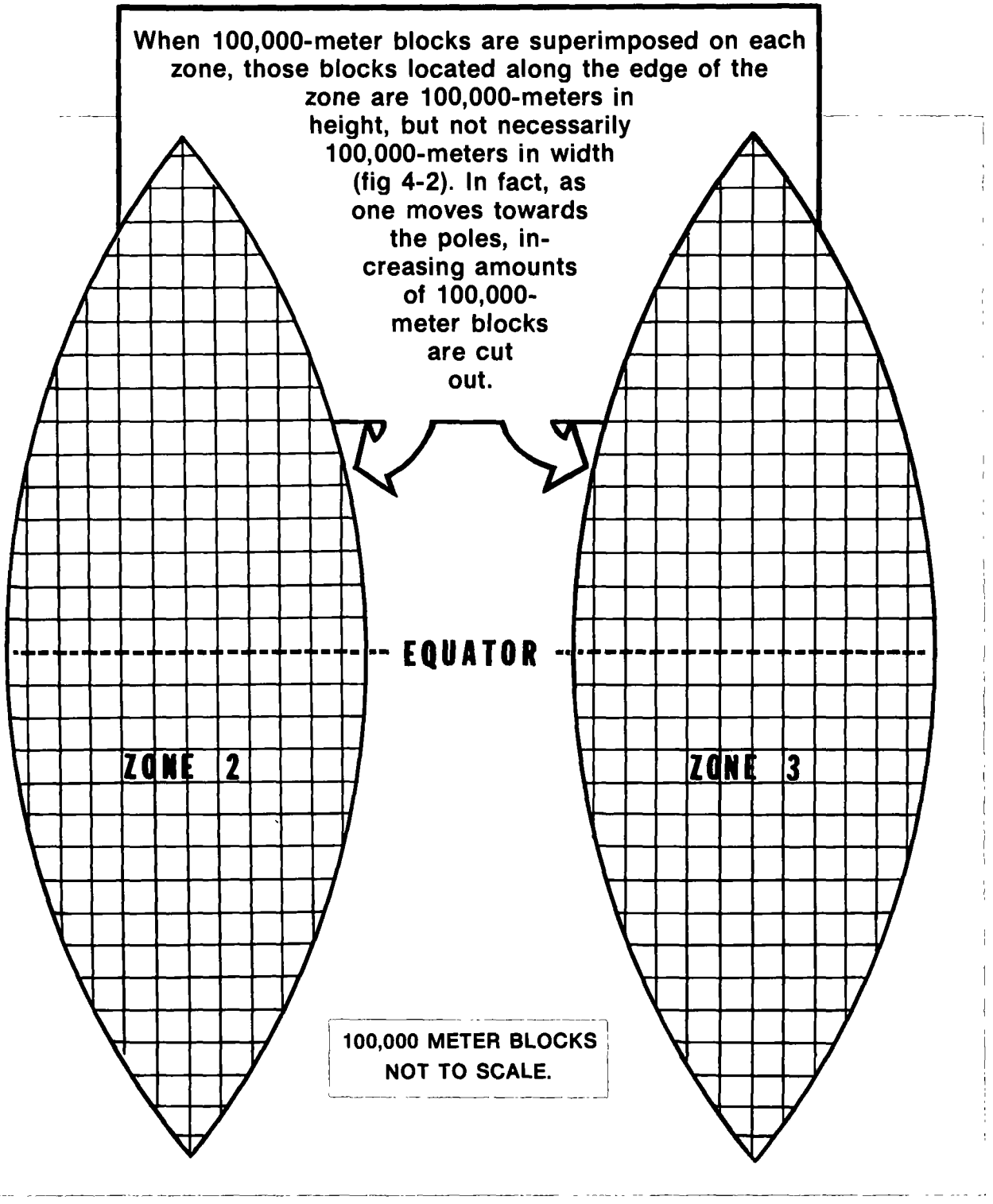

When 100,000-meter blocks are superimposed on each zone, those blocks located along the edge of the zone are 100,000-meters in height, but not necessarily 100,000-meters in width (fig 4-2). In fact, as one moves towards the poles, increasing amounts of 100,000-meter blocks are cut out.
EQUATOR
ZONE 2
ZONE 3
100,000 METER BLOCKS NOT TO SCALE.

Figure 4-2. GK zones 2 and 3.

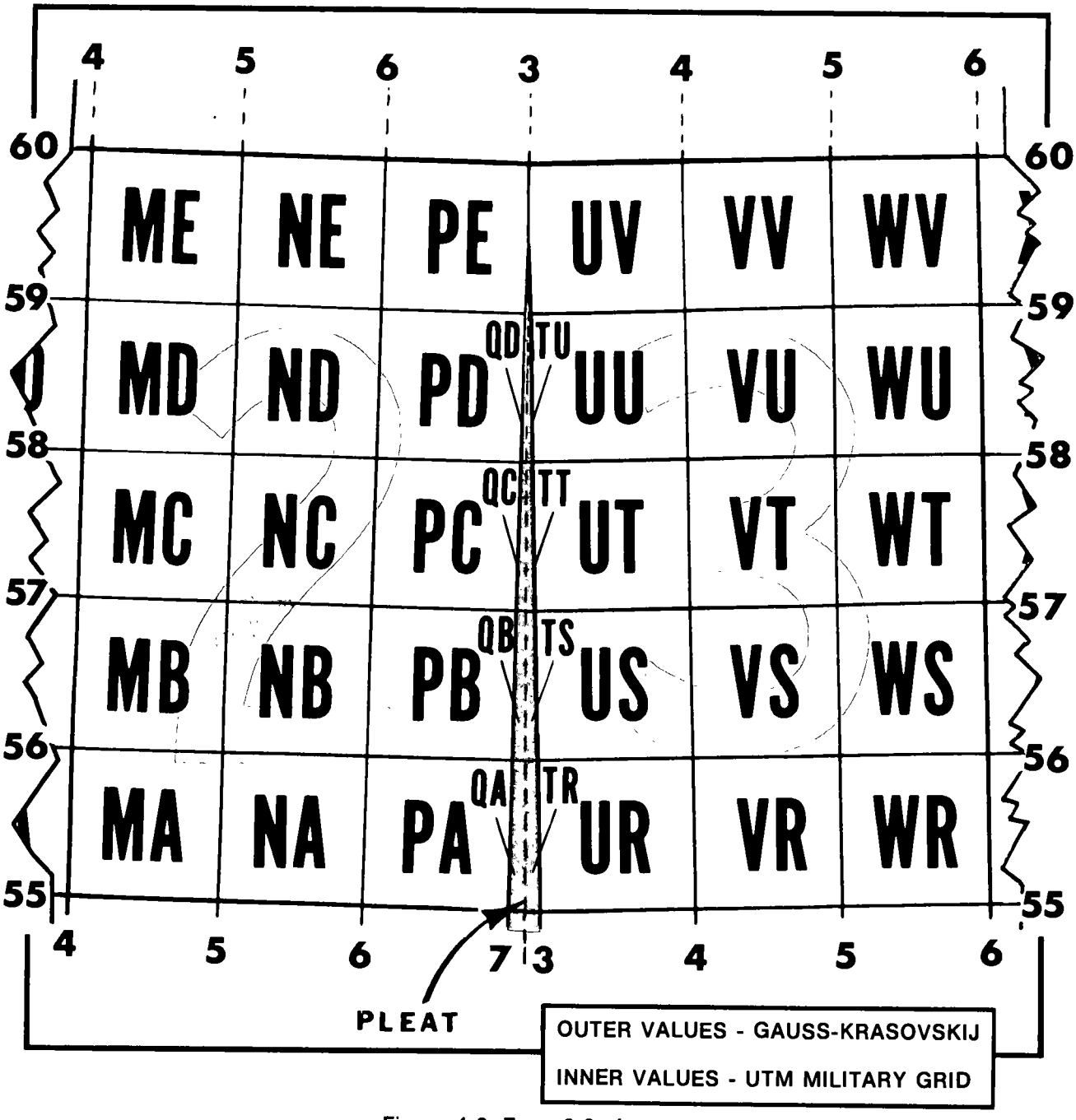


Figure 4-3. Zone 2-3 pleat.

The longitude line where these partial 100,000-meter blocks converge is often called a *pleat*. As you can see in figure 4-3, the north-south grid lines are not parallel but converge at an angle at the pleat. In this example, zones 2 and 3 are joined as they would be on a medium-scale map.

An example of how a medium-scale map (1:250,000) is formed with a pleat is shown in figure 4-4. Please note that a large-scale map (1:50,000) will rarely have a pleat within the map sheet. Rather, the pleat is the boundary. Normally, small-scale maps (1:1,000,000) are not used with the GK and UTM grid systems.

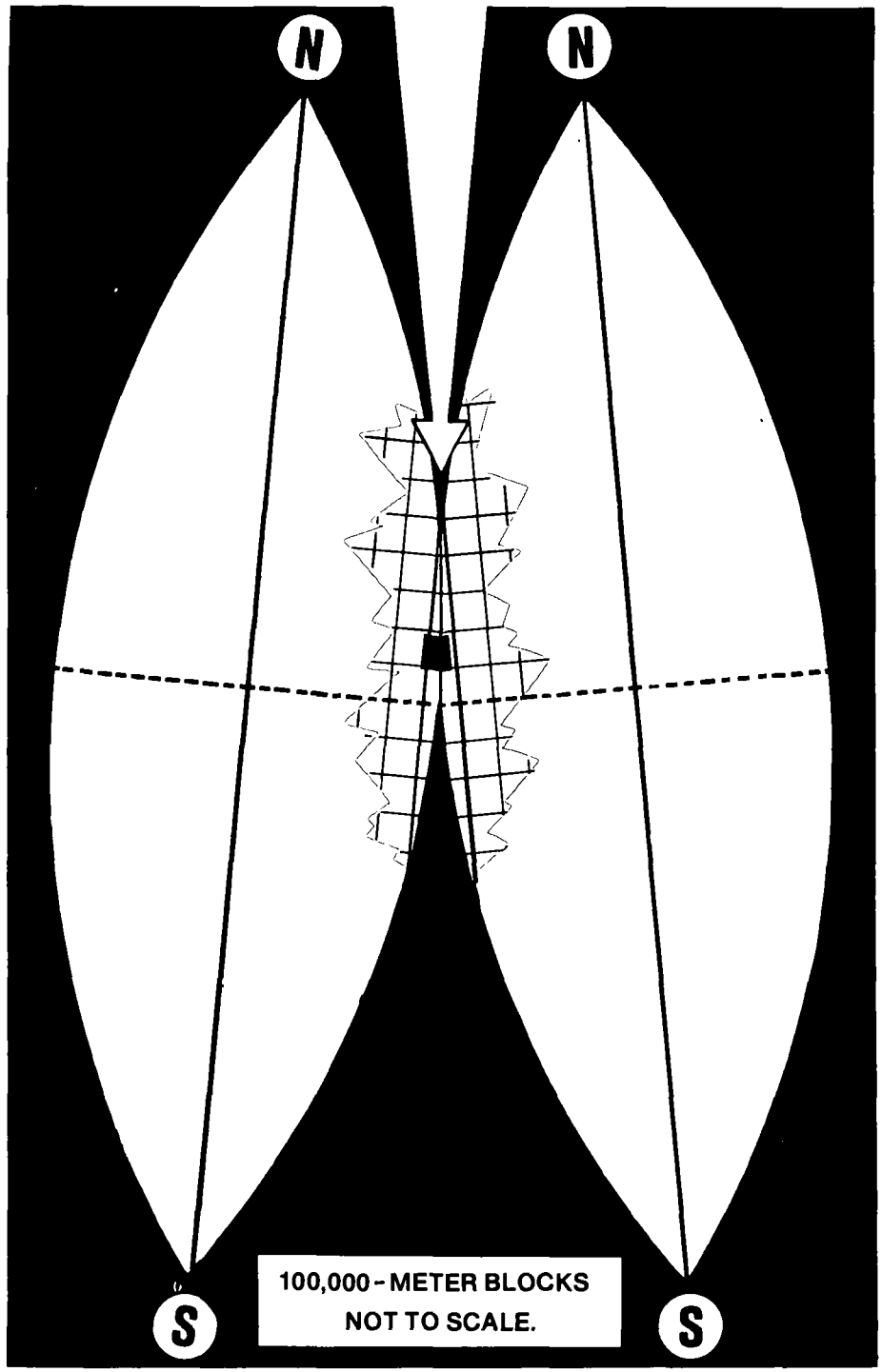


Figure 4-4.
GK zones 2 and 3.

NATO, as well as Warsaw Pact military forces, frequently use projected grids when operating (near the pleat) between adjacent zones. A typical pleat runs through East Germany at the 12° meridian and separates zones 2 and 3 (fig 4-5).

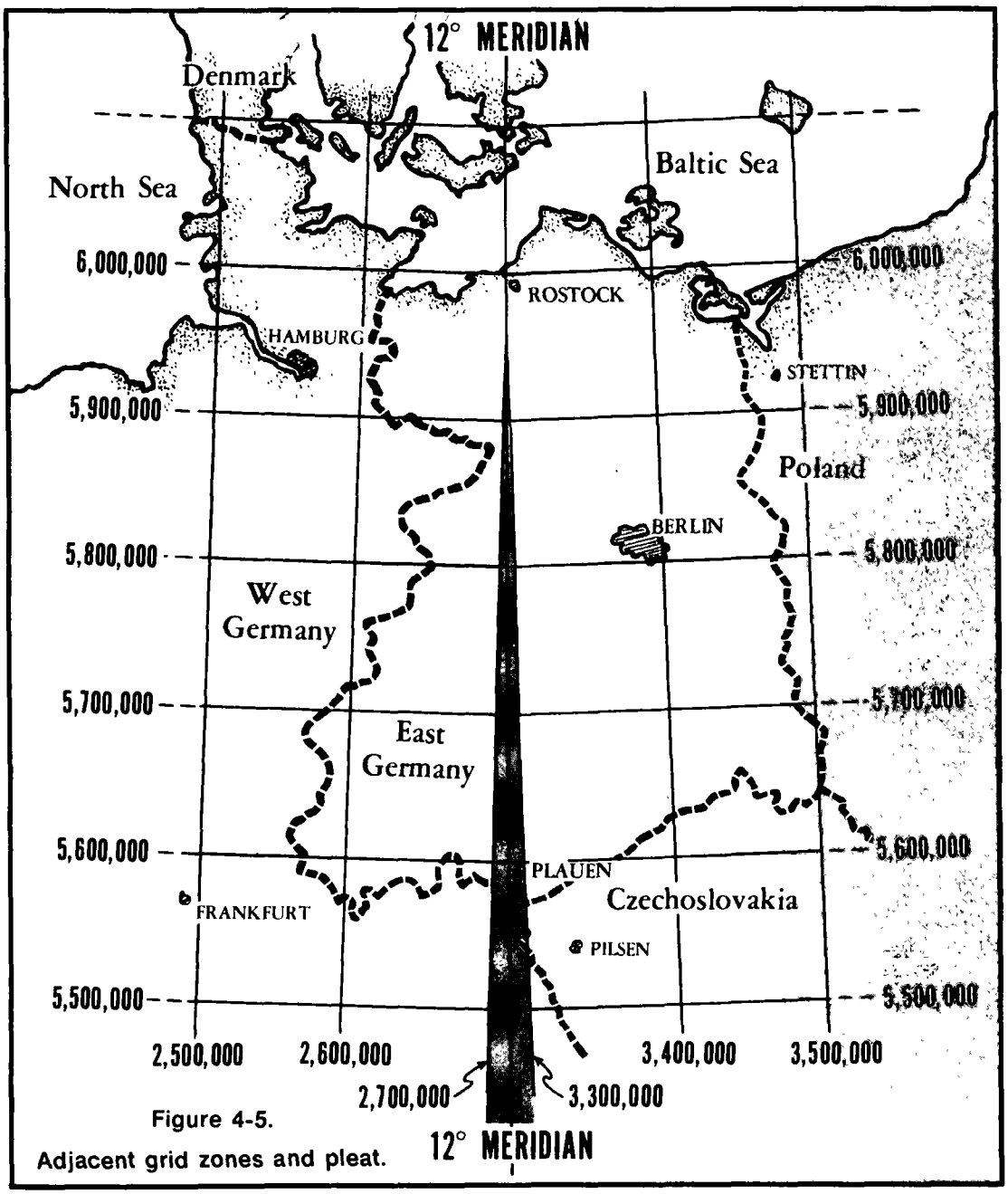


Figure 4-5.
Adjacent grid zones and pleat.

The angle of covergence at the pleat ranges from 0° at the Equator to 6° at the poles. For example, in East Germany the angle of convergence ranges from approximately 4° 37′ 54″ near Plauen in the south to 4° 51′ 37″ near Rostock in the north.

Because of this variation, maps are supplied that extend the grid pattern of adjacent zones across each other (fig 4-6). If a NATO or Warsaw Pact soldier is using a large-scale map when working with projected grids, he will need the adjacent map sheet. This is because the map boundary or neat line for a large-scale map is the pleat. Therefore, one would need the adjacent map sheet which is in the next zone.

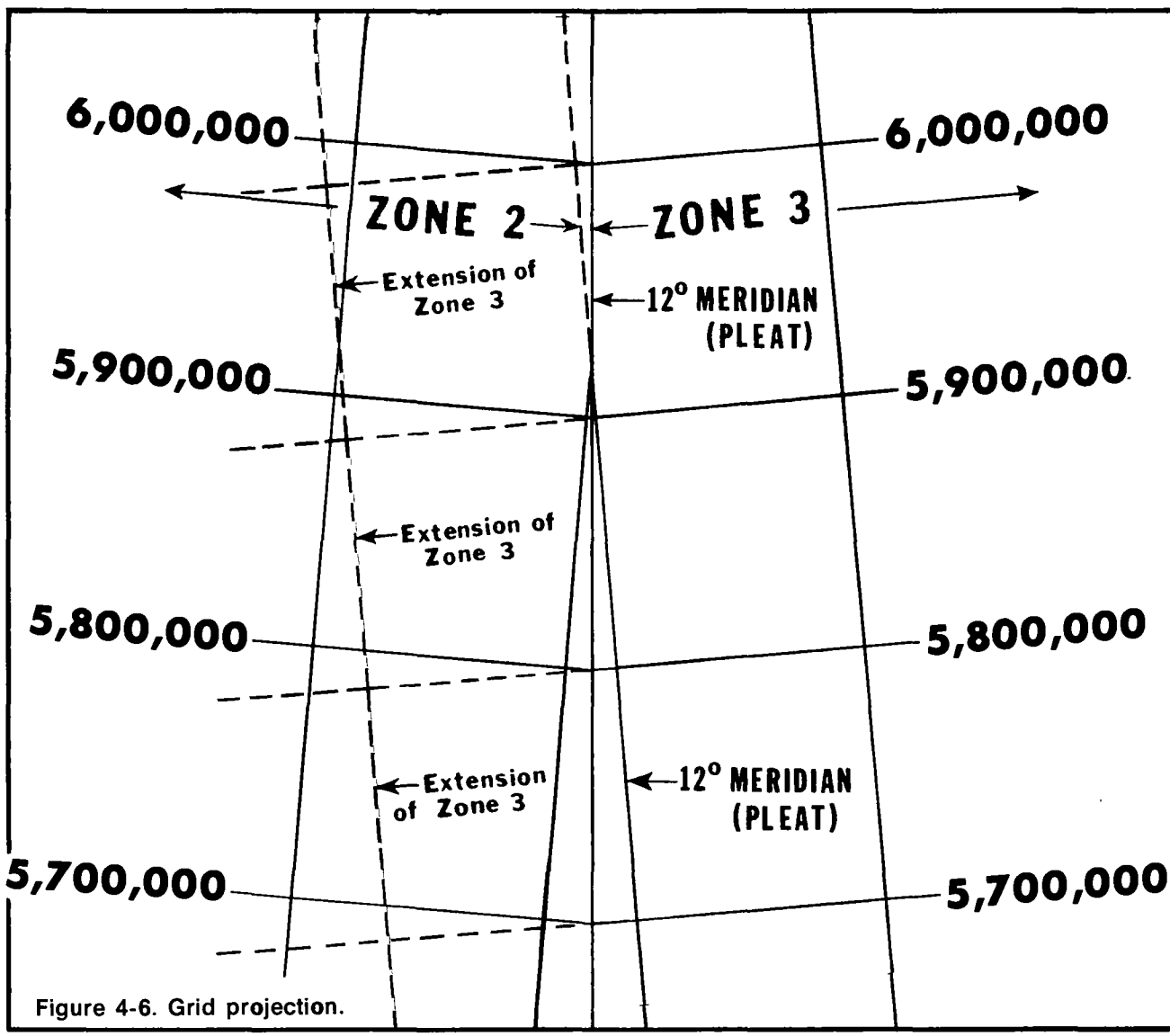


Figure 4-6. Grid projection.

Imagine that you are at 32U QA 045485. Illustrated in figure 4-7 is the adjacent map sheet you would need to project the grids. Note that the tick marks on the outside margins indicate the grid lines from the original zone (32U). Using these tick marks and a straightedge, the projected grid lines can be drawn on the map sheet as illustrated in figure 4-8 (dashed lines).

ADJACENT MAP SHEET

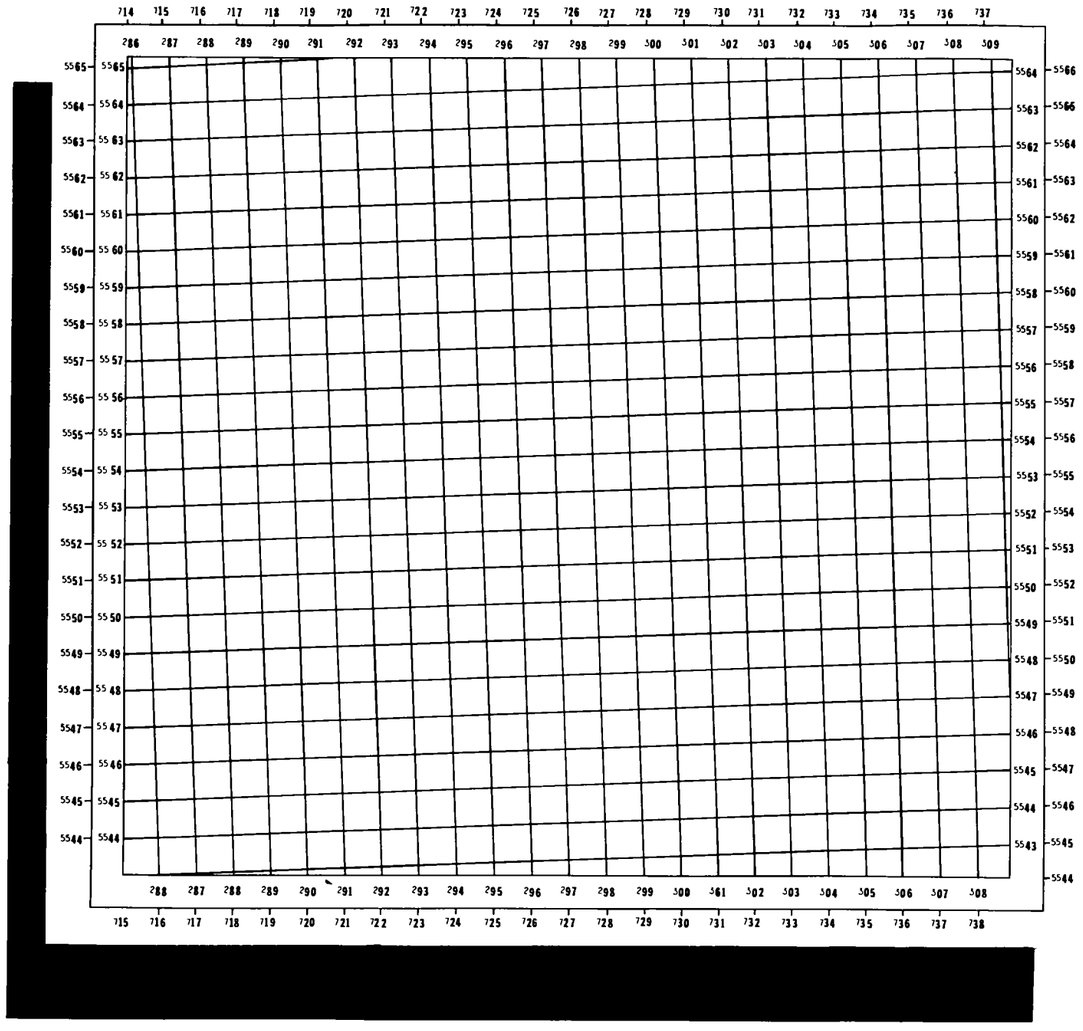


Figure 4-7. 33U TR 1:50,000 large scale (in miniature).

ADJACENT MAP SHEET WITH PROJECTED GRIDS

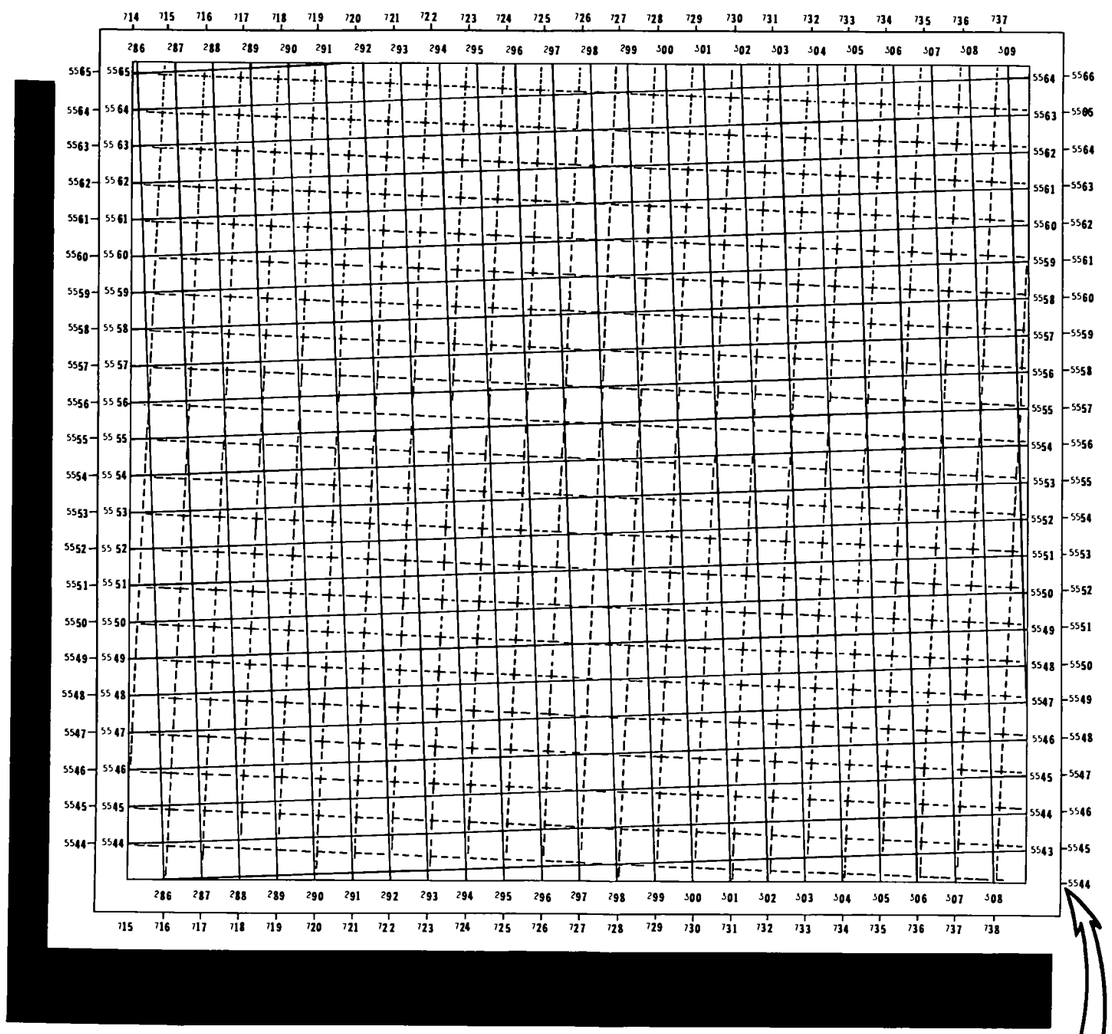


Figure 4-8. 33U TR 1:50,000 large scale (in miniature) with projected grids.

TICK MARKS WILL APPEAR IN BLUE ON 1:500,000 MAP SHEET.

Medium-scale maps present a somewhat different problem. Here the soldier can construct his own projected grid lines with a straightedge by extending the east-west lines across the pleat (fig 4-9).

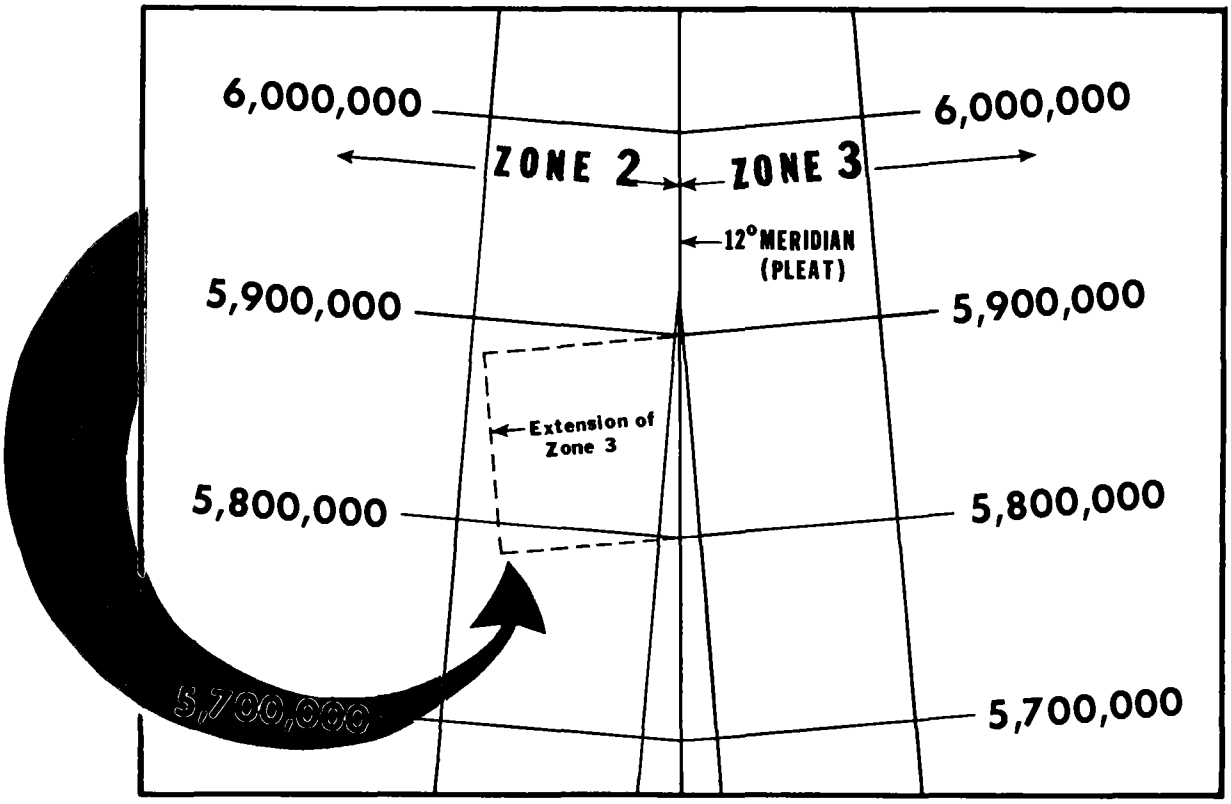


Figure 4-9. GK zone 3 grid projection.

Measurements within these partial 100,000-meter blocks are still made from the lower left corner of the full block. This concept is critical only within the partial blocks that are east of the pleat, as the lower left corner of these blocks has been cut out. In these blocks, measurements are made from where the lower left-hand corner would have been if the blocks had been drawn to their full 100,000-meter value. In figure 4-9, for example, you will see that the measurements for the projected zone 3 grid block, that is east of the pleat, begins at the lower left-hand corner (arrow). This projection technique makes plotting on the map easier and avoids complex computations and their accompanying errors. Thus, by using projection, a Warsaw Pact soldier can stand in zone 3 and report locations in zone 2 as if the locations were in zone 3. Conversely, projections may be made for blocks that fall across the pleat from zone 2 into zone 3.

As you remember from the explanation of the Gauss-Krasovskij grid system (chapter 2), each of the GK zones extends from pole to pole with its widest dimension being at the Equator and narrowing progressively as either pole is approached (fig 4-10). Each grid zone has its meridian or center line designated as the 500,000-meter line. This is also known as the zone center value (ZCV). All east or west measurements are taken from this meridian and decrease to the left (west) and increase to the right (east). Thus, for any northing, there is a *minimum easting* value at the left-hand edge and a *maximum easting* value at the right-hand edge of the zone. Projected grids will exceed these *minimum/maximum* limits.

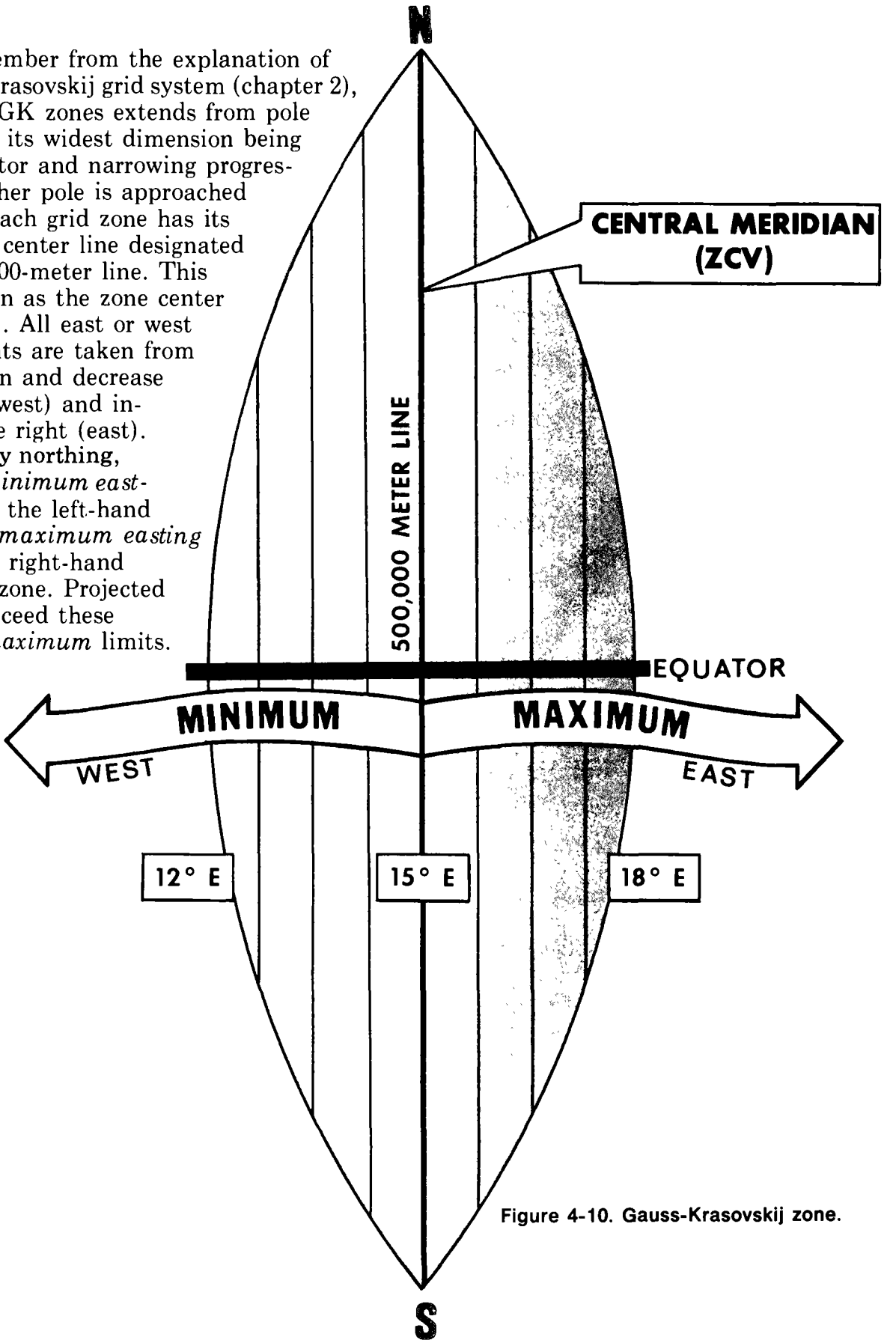


Figure 4-10. Gauss-Krasovskij zone.

Recognition of a Projected Grid

To determine if a GK grid is a projected grid, one must first convert the GK to a UTM military grid. Using the calculator or graph method, as explained in chapter 3, determine if the GK coordinates of 5652869 2718698 are projected. Converting the GK to a UTM grid value, you should arrive at 32U QB 18558 50660.

Now, if you try to find this location on a map, you will see that it does not exist because the QB block ends at the pleat before the easting can reach 18,000 meters. Therefore, the GK grid is projected from the GK zone 2 into GK zone 3 (fig 4-11).

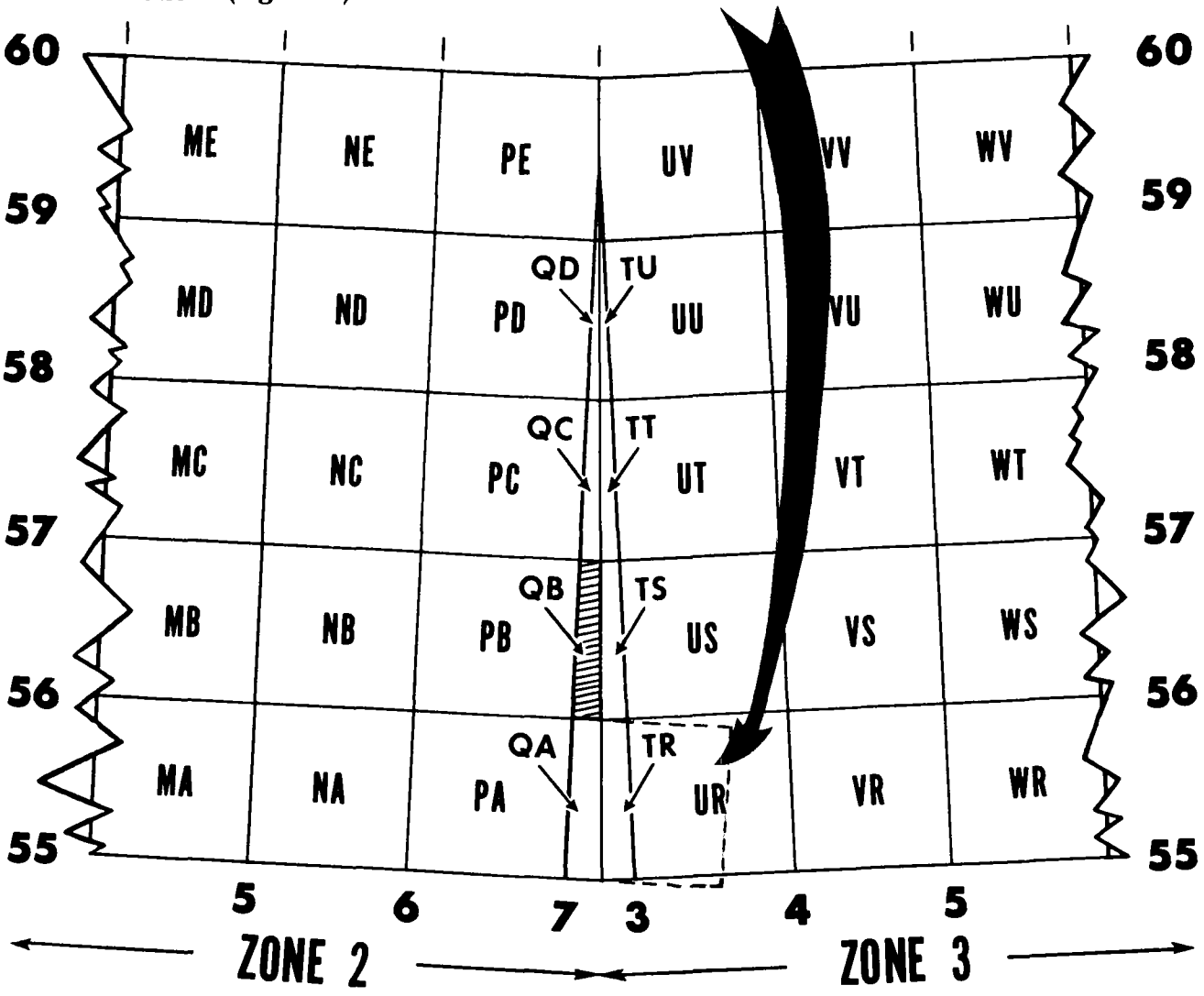
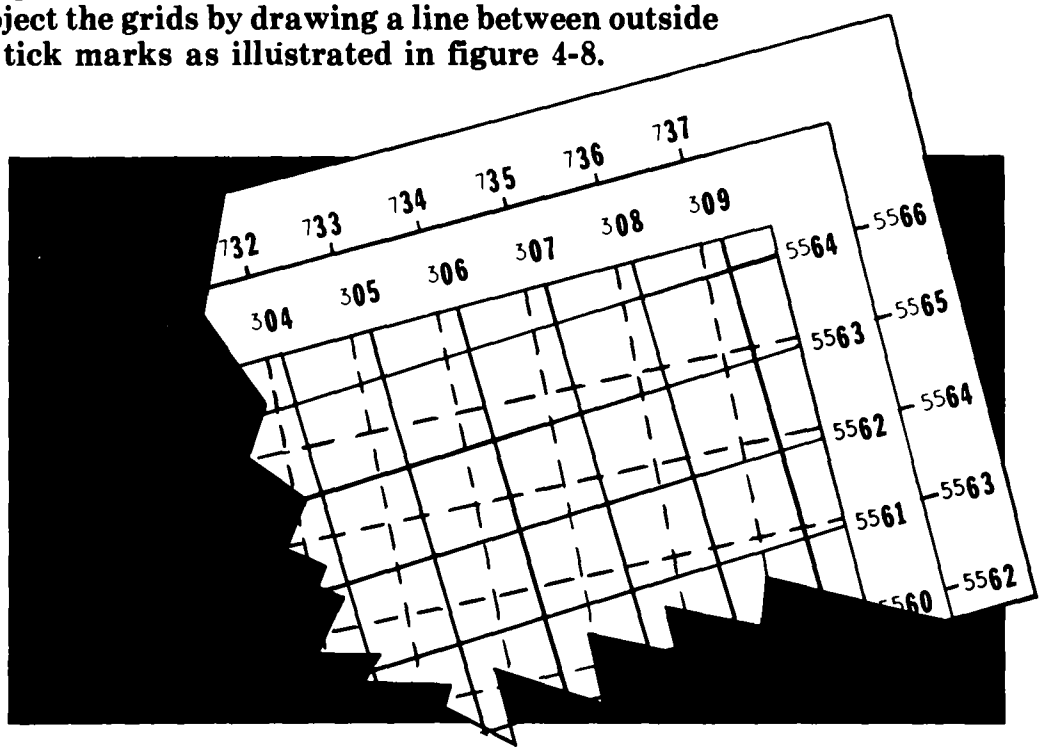
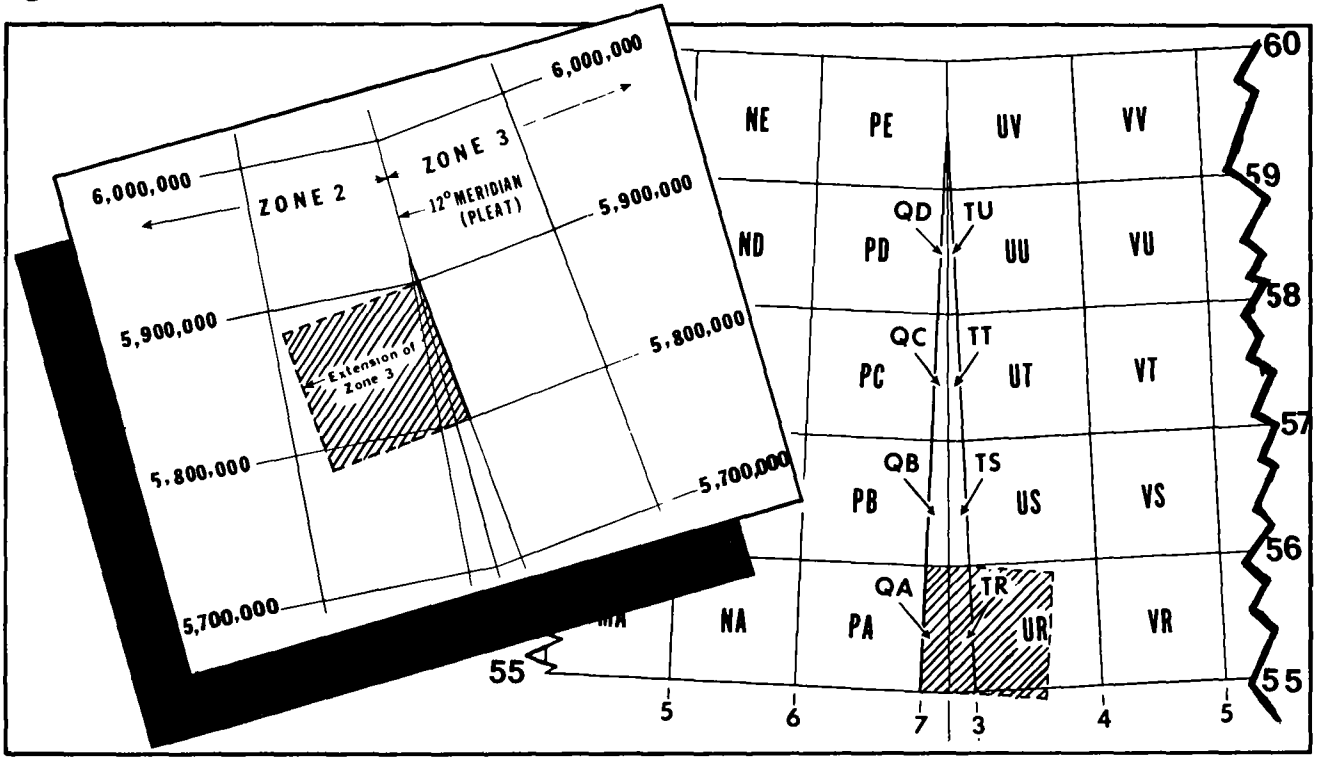


Figure 4-11. GK zone 2 projection into zone 3.

Having determined that the GK grid is projected, if you are using a large-scale map, you must obtain the adjacent map sheet. Project the grids by drawing a line between outside marginal tick marks as illustrated in figure 4-8.



If you are using a medium-scale map, extend the east-west lines across the pleat as illustrated in figures 4-9 and 4-11.

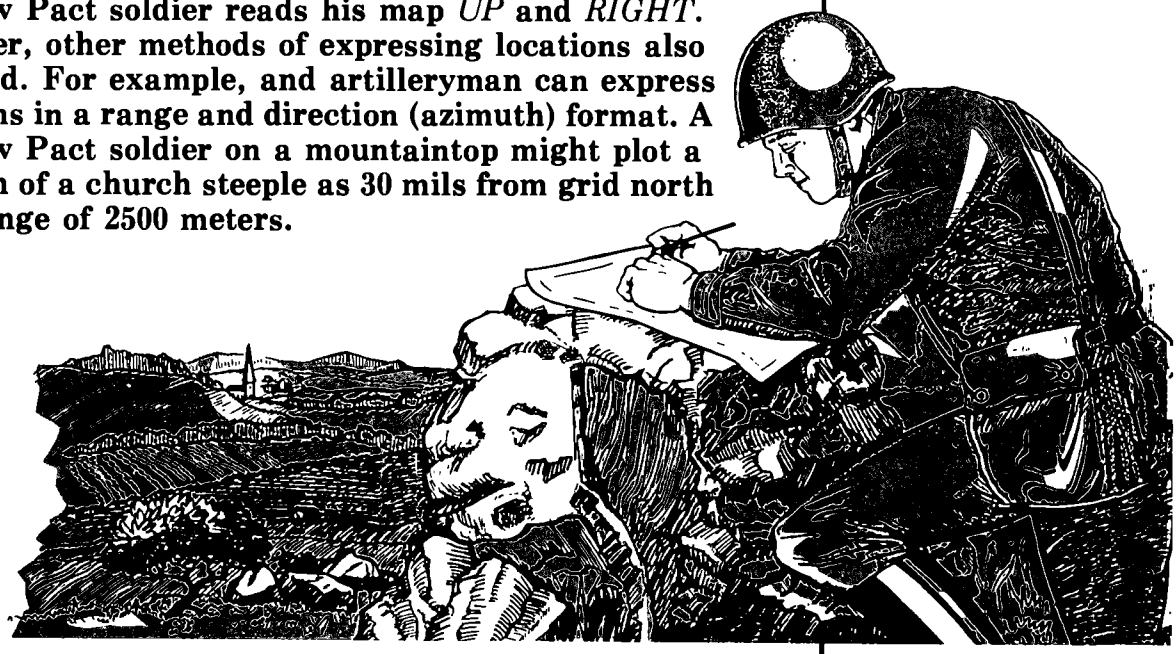


Chapter 5

CONVERSION FROM POLAR TO RECTANGULAR COORDINATES

General

The maps discussed in chapters 1, 2, and 3 use rectangular coordinates. Using a transverse Mercator projection, a set of north-south and east-west lines is superimposed upon the map surface and the resultant is referred to as the Universal Transverse Mercator (UTM) military grid system. Warsaw Pact countries use a transverse cylindrical Gauss-Krasovskij (GK) projection which is similar, but not identical, to the transverse Mercator. North-south and east-west lines also are superimposed on the GK projection. Locations on both types of maps are expressed in meters from the north-south and east-west lines. NATO soldiers determine a location by reading *RIGHT* and *UP* whereas a Warsaw Pact soldier reads his map *UP* and *RIGHT*. However, other methods of expressing locations also are used. For example, and artilleryman can express locations in a range and direction (azimuth) format. A Warsaw Pact soldier on a mountaintop might plot a location of a church steeple as 30 mils from grid north at a range of 2500 meters.



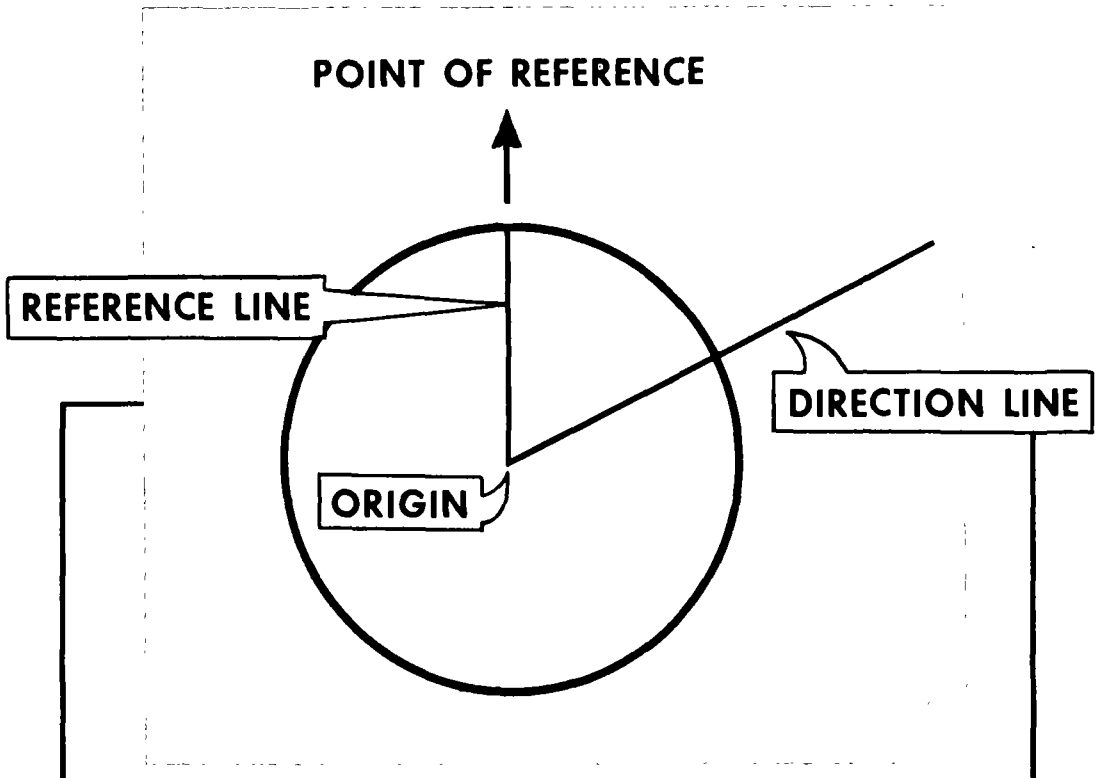


Figure 5-1. Direction line.

BASELINES AND DIRECTION

In order to measure any angle, there must be an origin or zero measurement and a point of reference. These two points designate the base or reference line (fig 5-1).

There are three standard points of reference: **true north, magnetic north, and grid north** (fig 5-2).

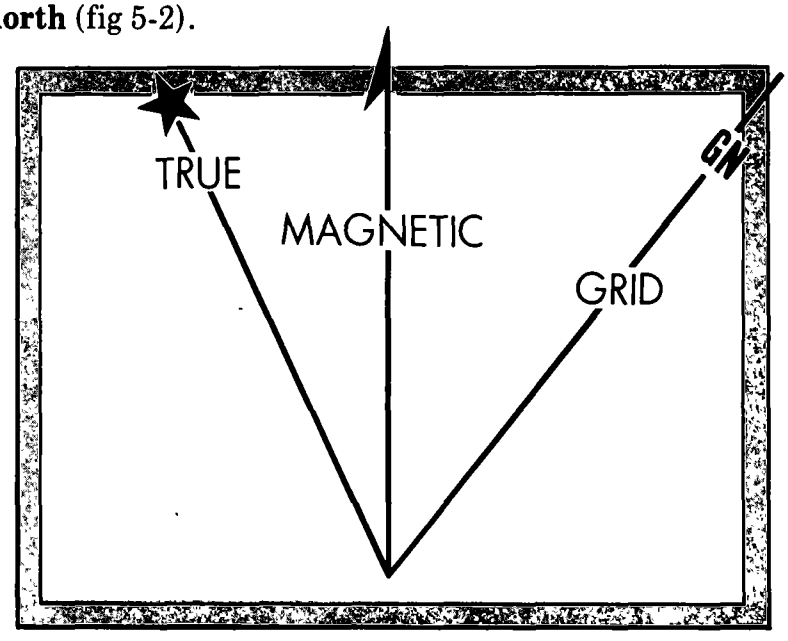
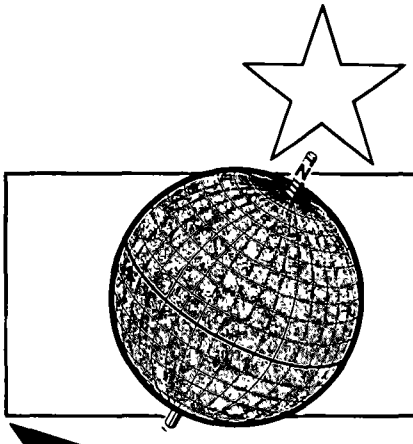
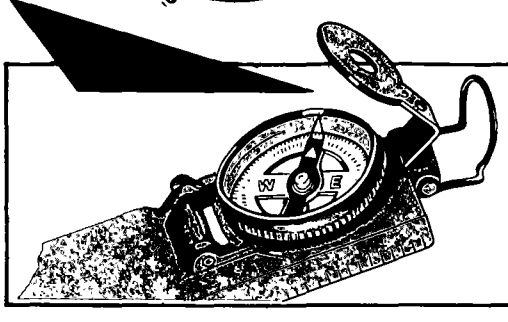


Figure 5-2. True, magnetic, and grid north reference points.



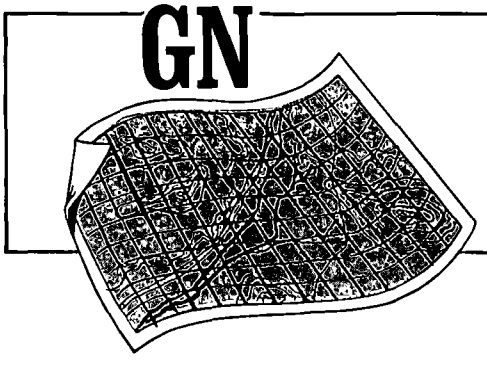
TRUE NORTH

The direction from any position on the earth's surface to the north pole. All lines of longitude are true north lines. This reference point is symbolized by a star.



MAGNETIC NORTH

The direction to the north magnetic pole as indicated by a compass. This reference point is symbolized by a half arrowhead.



GRID NORTH

The north that is established by the vertical grid lines on the map. This reference point is symbolized by the letters GN.

The polar coordinate system normally uses grid north as its starting point or reference line. As indicated in figure 5-3, NATO measurements are clockwise from the reference line.

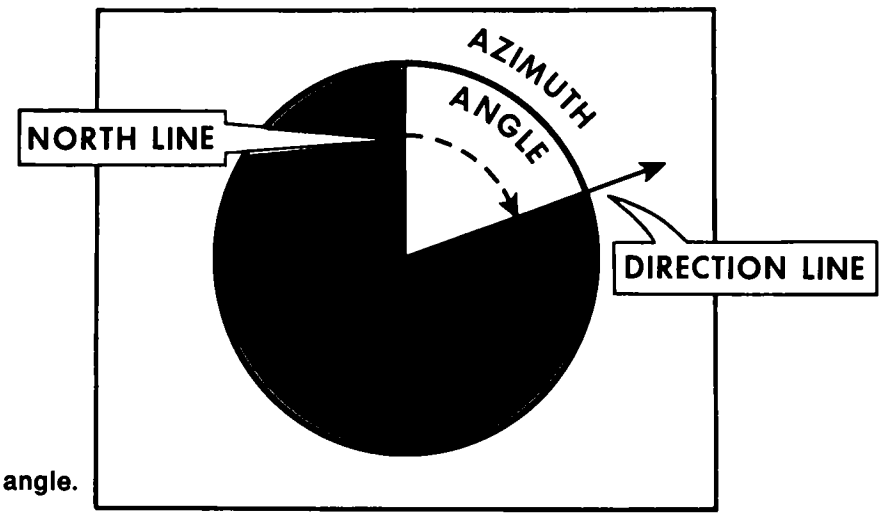


Figure 5-3. Azimuth angle.

The unit of angular measurement is the mil: a circle is divided into 6,400 mils. Using the polar coordinate system, a point on a map may be determined or plotted from a known point by giving direction and distance along the direction line.

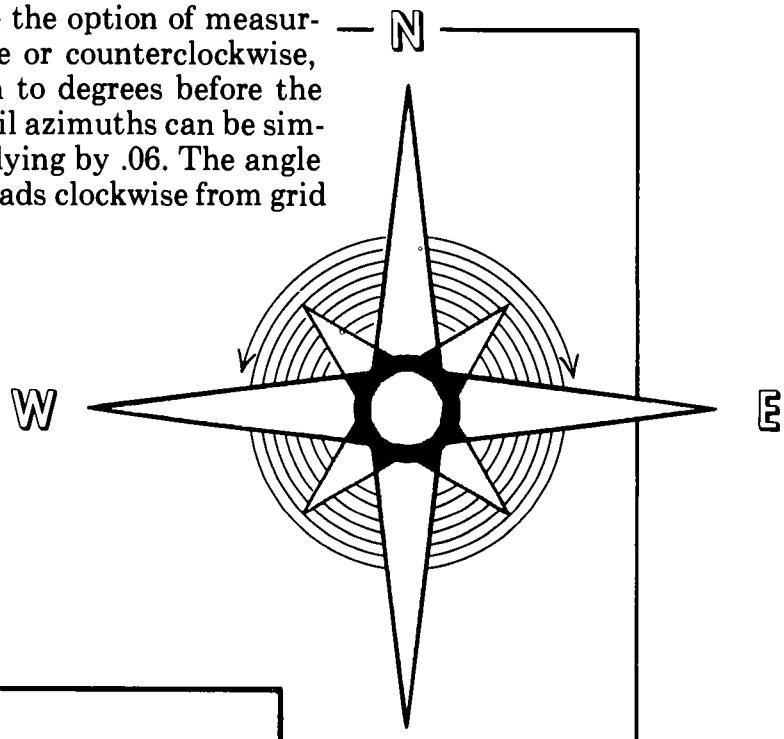
Significant differences exist between NATO and Warsaw Pact utilization of this system. For example, while our soldiers use 6,400 mils to equal 360°, Warsaw Pact soldiers divide a circle into 6,000 mils. Additionally, while our measurements are clockwise from the reference line, Warsaw Pact soldiers have the option of measuring their azimuth either *clockwise* or *counterclockwise*. Normally, the counterclockwise measurements are only used for special purposes and measurements. While Warsaw Pact forces generally measure clockwise from grid north, they may also measure either clockwise or counterclockwise from a reference point other than grid north.

The Conversion Process

In the following conversion exercises, we will use the Warsaw Pact expression (6,000 mils = 360°). For computation ease, the following information is provided:

- **1 mil equals .06°**
- **1° equals 16.67 mils**

Since the Warsaw Pact forces have the option of measuring their azimuths either clockwise or counterclockwise, you must convert the mil azimuth to degrees before the following explanation can apply. Mil azimuths can be simply converted to degrees by multiplying by .06. The angle must then be converted so that it reads clockwise from grid north (fig 5-4).



Note!

To assist in determining angular measurement, the following conversion information is provided. See table for clockwise or counterclockwise measurements.

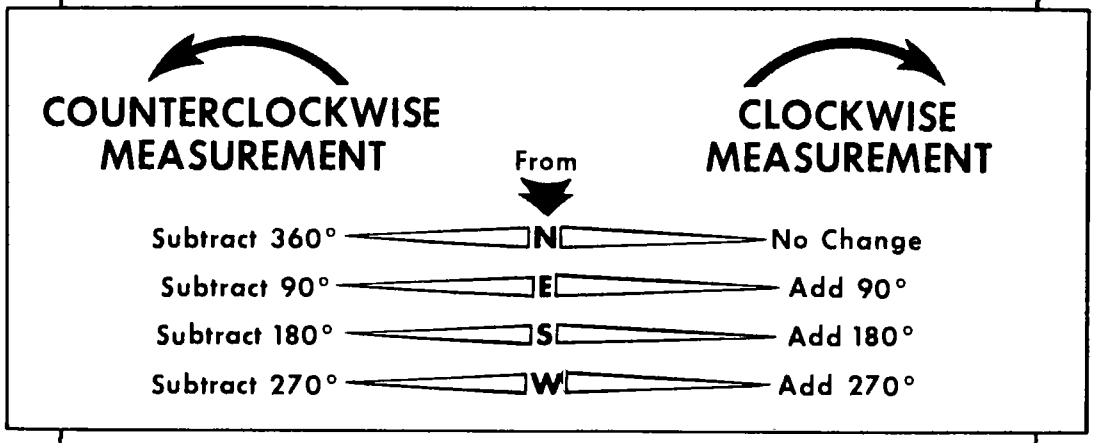
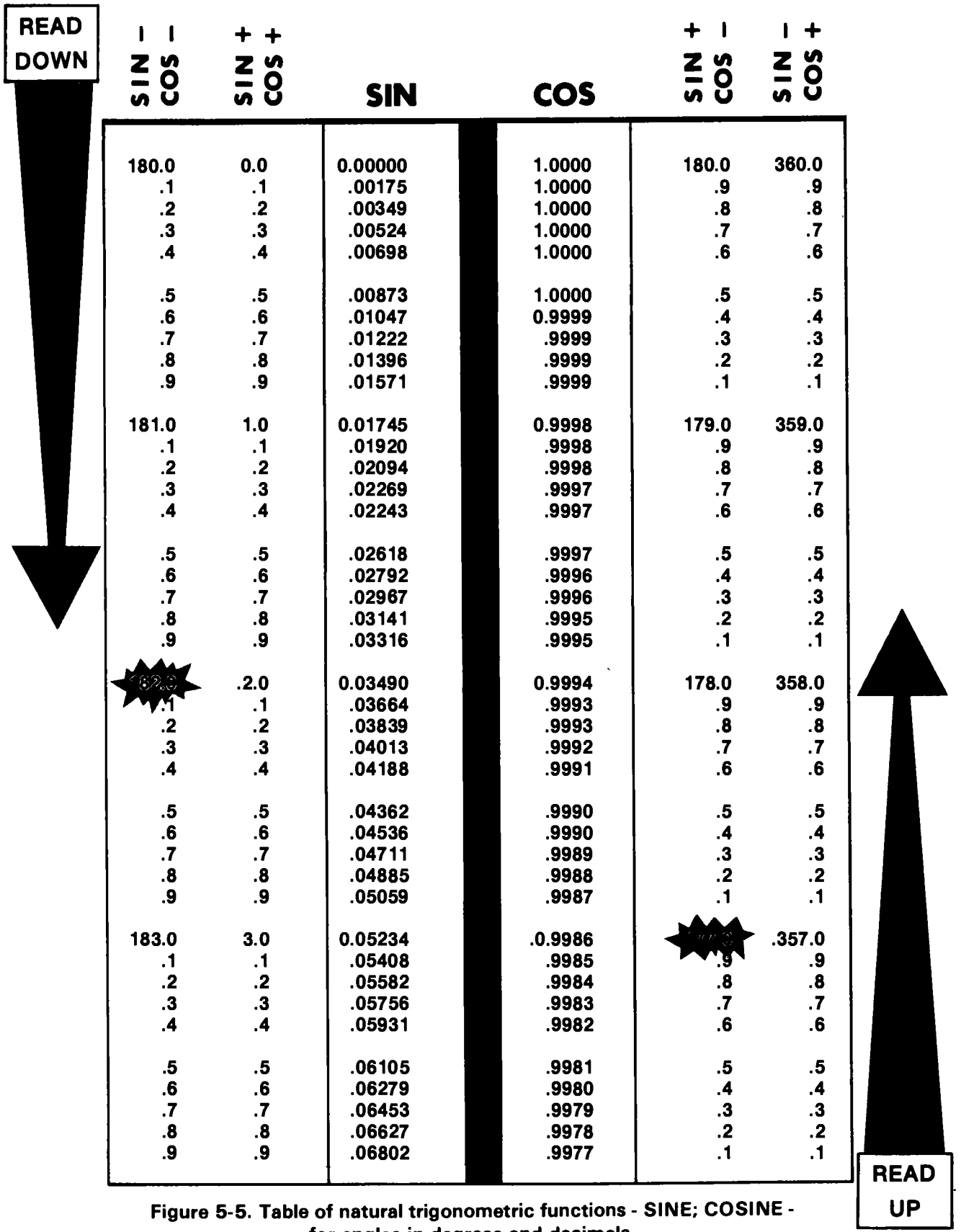


Figure 5-4. Angular conversion table.

Once the Warsaw Pact mil reading has been converted to degrees, the conversion of polar to rectangular coordinates requires a minimal use of trigonometry involving the SINE and COSINE functions. The values for SINE and COSINE can be obtained from the tables of natural trigonometric functions contained in appendix G or from a hand calculator with trigonometric functions.



SIN − COS −	SIN + COS +	SIN	COS	SIN + COS −	SIN − COS +
180.0	0.0	0.00000	1.0000	180.0	360.0
.1	.1	.00175	1.0000	.9	.9
.2	.2	.00349	1.0000	.8	.8
.3	.3	.00524	1.0000	.7	.7
.4	.4	.00698	1.0000	.6	.6
.5	.5	.00873	1.0000	.5	.5
.6	.6	.01047	0.9999	.4	.4
.7	.7	.01222	.9999	.3	.3
.8	.8	.01396	.9999	.2	.2
.9	.9	.01571	.9999	.1	.1
181.0	1.0	0.01745	0.9998	179.0	359.0
.1	.1	.01920	.9998	.9	.9
.2	.2	.02094	.9998	.8	.8
.3	.3	.02269	.9997	.7	.7
.4	.4	.02243	.9997	.6	.6
.5	.5	.02618	.9997	.5	.5
.6	.6	.02792	.9996	.4	.4
.7	.7	.02967	.9996	.3	.3
.8	.8	.03141	.9995	.2	.2
.9	.9	.03316	.9995	.1	.1
[illegible]	.2.0	0.03490	0.9994	178.0	358.0
.1	.1	.03664	.9993	.9	.9
.2	.2	.03839	.9993	.8	.8
.3	.3	.04013	.9992	.7	.7
.4	.4	.04188	.9991	.6	.6
.5	.5	.04362	.9990	.5	.5
.6	.6	.04536	.9990	.4	.4
.7	.7	.04711	.9989	.3	.3
.8	.8	.04885	.9988	.2	.2
.9	.9	.05059	.9987	.1	.1
183.0	3.0	0.05234	.0.9986	[illegible]	.357.0
.1	.1	.05408	.9985	.9	.9
.2	.2	.05582	.9984	.8	.8
.3	.3	.05756	.9983	.7	.7
.4	.4	.05931	.9982	.6	.6
.5	.5	.06105	.9981	.5	.5
.6	.6	.06279	.9980	.4	.4
.7	.7	.06453	.9979	.3	.3
.8	.8	.06627	.9978	.2	.2
.9	.9	.06802	.9977	.1	.1

Figure 5-5. Table of natural trigonometric functions - SINE; COSINE - for angles in degrees and decimals.

The natural trigonometric functions table for SINE and COSINE is illustrated in figure 5-5. As you can see, the table is divided into two major trigonometric columns SIN (SINE) and COS (COSINE). These functions are separated by a heavy dark line. There are two columns of degrees to the left of the SIN functions and two columns to the right of the COS functions. The table is divided into tenths and allows the computation of SINE and COSINE for each tenth of a degree from 0° throught 359°. Natural trigonometric functions tables normally are computed for 0° to 90°; however, since there are four quadrants (figure 5-6), the SINE and COSINE for all 360° in tenths are provided.

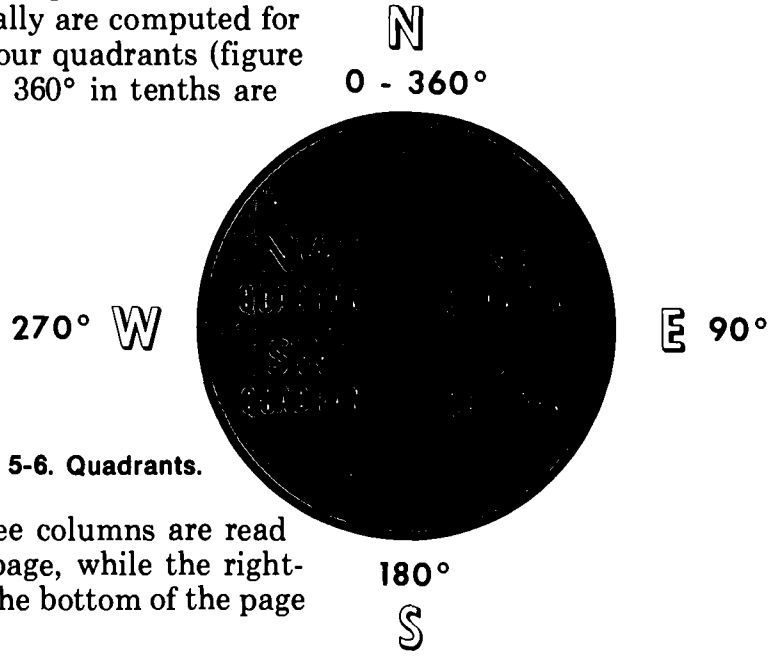


Figure 5-6. Quadrants.

Please note that the left-hand degree columns are read from the top to the bottom of the page, while the right-hand degree columns are read from the bottom of the page to the top.

Converting polar coordinates to GK coordinates without the aid of a hand calculator is not difficult; however, you must be able to determine the SINE and COSINE from the natural trigonometric functions table (appendix G). To determine the COSINE for 182°, for example, refer to figure 5-5. First, read down the left-hand column until you come to 182°. Next, locate the COSINE column (COS) at the top of the table and proceed down the column, stopping on the 182° line. The COSINE of 182° is 0.9994. Please note that the same COSINE for 182° is also applicable for 2.0°, 178.0°, and 358.0° as well. However, the sign (plus or minus) may differ.

Again referring to figure 5-5, determine the SINE of 177°. First, read up the right-hand column until you locate 177°. Remember the trigonometric function is read from the bottom of the table for all angular values on the right column. After finding 177°, locate the SINE column (SIN) at the top of the page and proceed up the column stopping on the 177° line. The SINE of 177° is 0.05234.

If you are using a hand calculator to determine trigonometric functions of SINE and COSINE, the sign of the function (+ or -) is automatically indicated. When manually converting polar coordinates, you must determine the appropriate sign of the function.

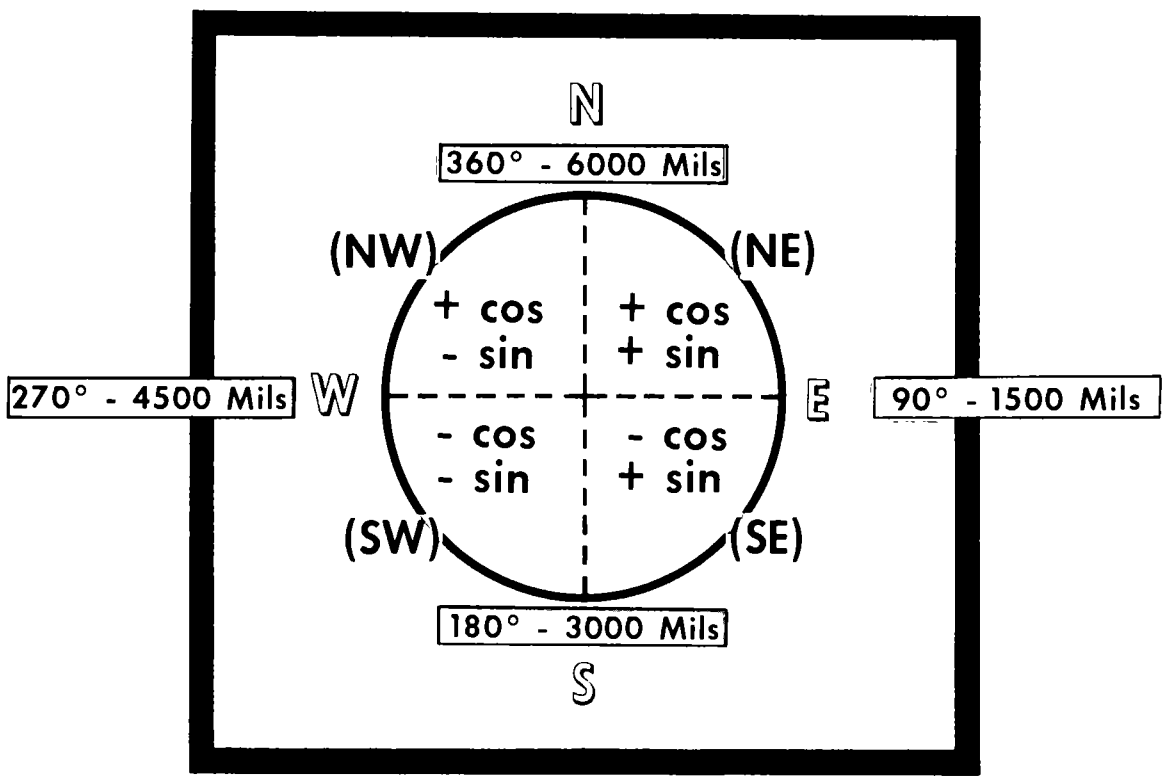
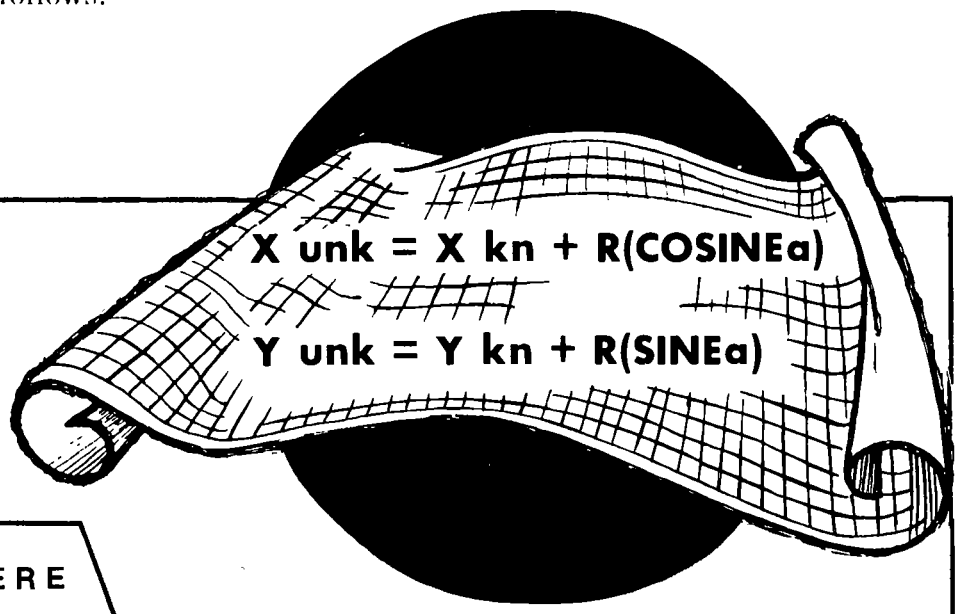


Figure 5-7. Signs for each quadrant.

Illustrated in figure 5-7 is a circle that is divided into the four quadrants and indicates the appropriate sign (+ or -) for the SINE and COSINE within each quadrant. To accurately complete the conversion process, it is imperative that you use the correct sign. If the direction line is located within the southeast (SE) quadrant for example, the SINE is positive and the COSINE is negative. A direction line located within the northeast (NE) quadrant would use a positive SINE and a positive COSINE in the conversion formula. Looking again at the natural trigonometric functions table (fig 5-5), you will see the correct sign (+ or -) indicated above each degree column.

Conversion Formulas

The formulas for conversion of polar to rectangular coordinates are as follows:



WHERE

X unk	=	GK northing (7 digits) of the *unknown* point.
X kn	=	GK northing (7 digits) of the *known* point.
Y unk	=	GK easting (7 digits) of the *unknown* point.
Y kn	=	GK easting (7 digits) of the *known* point.
R	=	Map range in meters.
a	=	Angle from known point *to* unknown point as measured from grid north.

Now, try out the formulas with the following five problems.

Note!

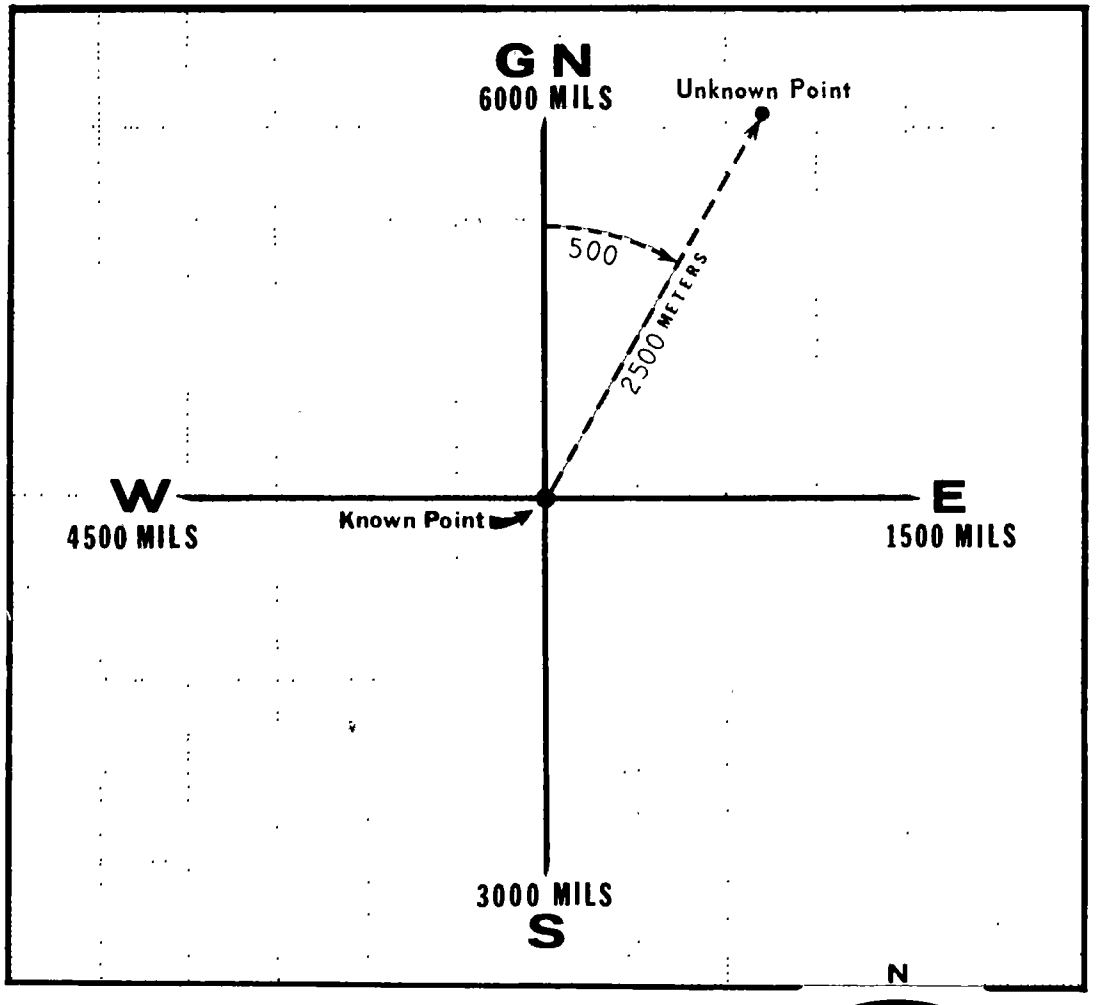
The mathematical steps in the following problems are not rounded off to the next higher number.

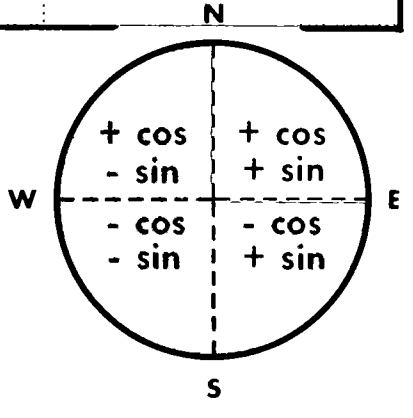
PROBLEM 1

Known Point ● 5826615 2591730

Range (RGE) ● 2500 meters

Mils ● 500 clockwise from grid north





PROBLEM 1

GIVEN: GK Coordinates 5826615 2591730

RGE 2500 meters

Mils 500 clockwise from grid north

Northing Formula ○ X unk = X kn + R(COSINEa)

Step 1	Substitute known values.	X unk = 5826615 + 2500 [COSINE (.06 X 500)]
Step 2	Determine a. (To change mils to degrees, multiply by .06.)	X unk = 5826615 + 2500 [COSINE 30]
Step 3	Determine COSINE of 30 degrees from appendix G. (The sign is positive as 30 degrees is within the NE quadrant.)	X unk = 5826615 + 2500 [.8660]
Step 4	Multiply result.	X unk = 5826615 + 2165
Step 5	Add.	X unk = 5828780

Easting Formula ○ Y unk = Y kn + R(SINEa)

Step 1	Substitute known values.	Y unk = 2591730 + 2500 [SINE (.06 X 500)]
Step 2	Determine a. (To change mils to degrees, multiply by .06.)	Y unk = 2591730 + 2500 [SINE 30]
Step 3	Determine SINE of 30 degrees from appendix G. (The sign is positive as 30 degrees is within the NE quadrant.)	Y unk = 2591730 + 2500 [.5000]
Step 4	Multiply result.	Y unk = 2591730 + 1250
Step 5	Add.	Y unk = 2592980

The X unk and Y unk have now been solved and are GK coordinates 5828780 2592980.

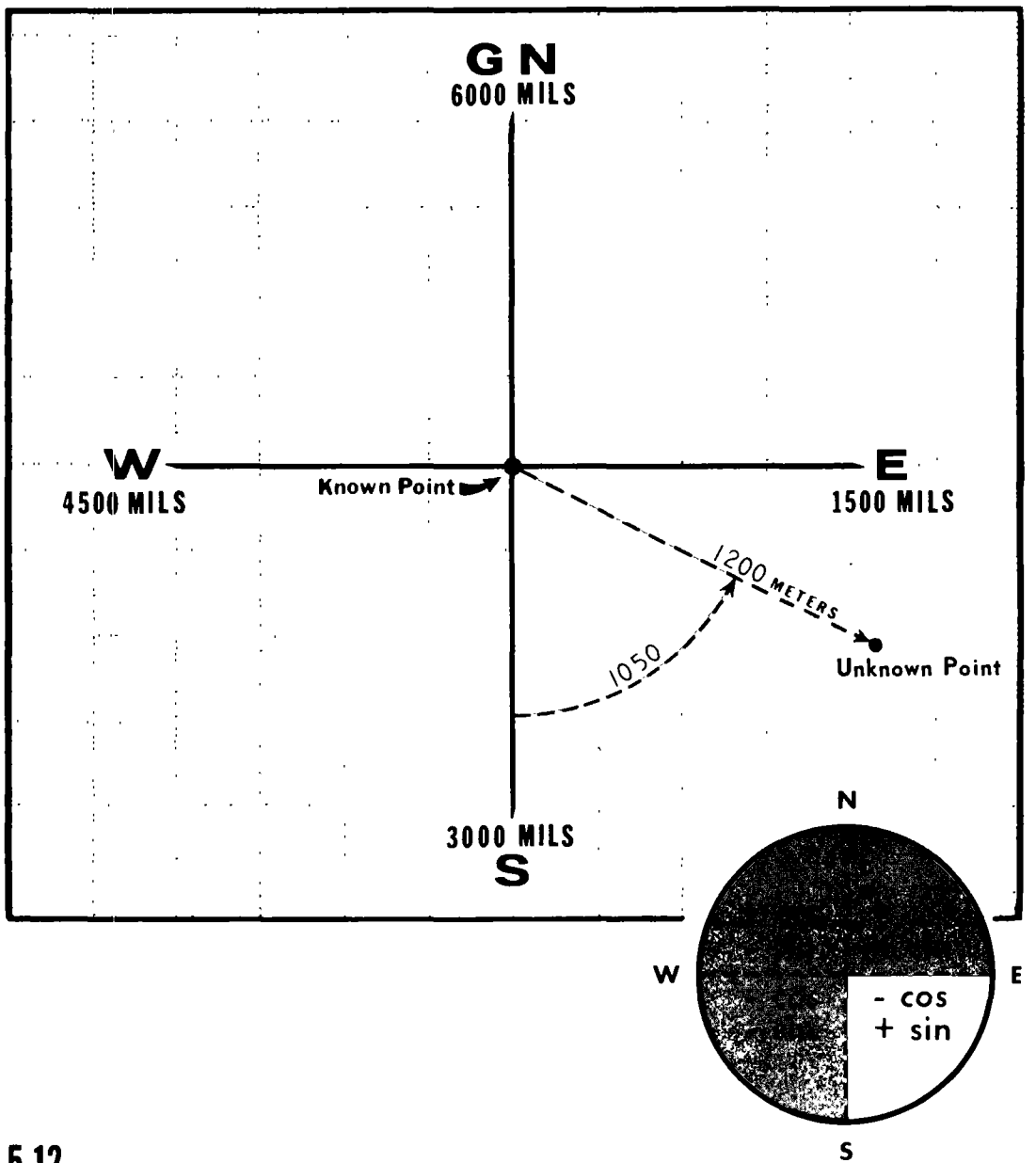
PROBLEM 2

As previously stated, Warsaw Pact soldiers can measure clockwise or counterclockwise from any of the four compass points. Additionally, to perform the conversion, you must convert the mil azimuth to degrees as measured clockwise from grid north. Problem 2 is an example of a GK polar coordinate that is measured counterclockwise from grid south. To transform the angle so that it is clockwise from grid north, first convert the mils to degrees by multiplying by .06. Then, subtract the result from 180°.

Known Point ● 5826615 2591730

Range (RGE) ● 1200 meters

Mils ● 1050 counterclockwise from grid south



PROBLEM 2

GIVEN: GK Coordinates 5826615 2591730
RGE 1200 meters
Mils 1050 counterclockwise from grid south

Northing Formula ① X unk = X kn + R(COSINEa)

Step 1	Substitute known values.	X unk = 5826615 + 1200 [COSINE (.06 X 1050)
Step 2	Determine a. (To change mils to degrees, multiply by .06.)	X unk = 5826615 + 1200 [COSINE 63]
Step 3	Subtract a from 180. (Angle must be clockwise from grid north.)	X unk = 5826615 + 1200 [COSINE 117]
Step 4	Determine COSINE of 117 degrees from appendix G. (The sign is negative as 117 degrees is within the SE quadrant.)	X unk = 5826615 + 1200 [-.4540]
Step 5	Multiply result.	X unk = 5826615 -544
Step 6	Add.	X unk = 5826071

Easting Formula ② Y unk = Y kn + R(SINEa)

Step 1	Substitute known values. (Note: 117 degrees was computed in steps 2/3 above.)	Y unk = 2591730 + 1200 (SINE 117)
Step 2	Determine SINE of 117 degrees from appendix G. (The sign is positive as 117 degrees is within the SE quadrant.)	Y unk = 2591730 + 1200 (.8910)
Step 3	Multiply result.	Y unk = 2591730 + 1069
Step 4	Add.	Y unk = 2592799

The X unk and Y unk have now been solved and the unknown location is GK coordinates **5826071 2592799.**

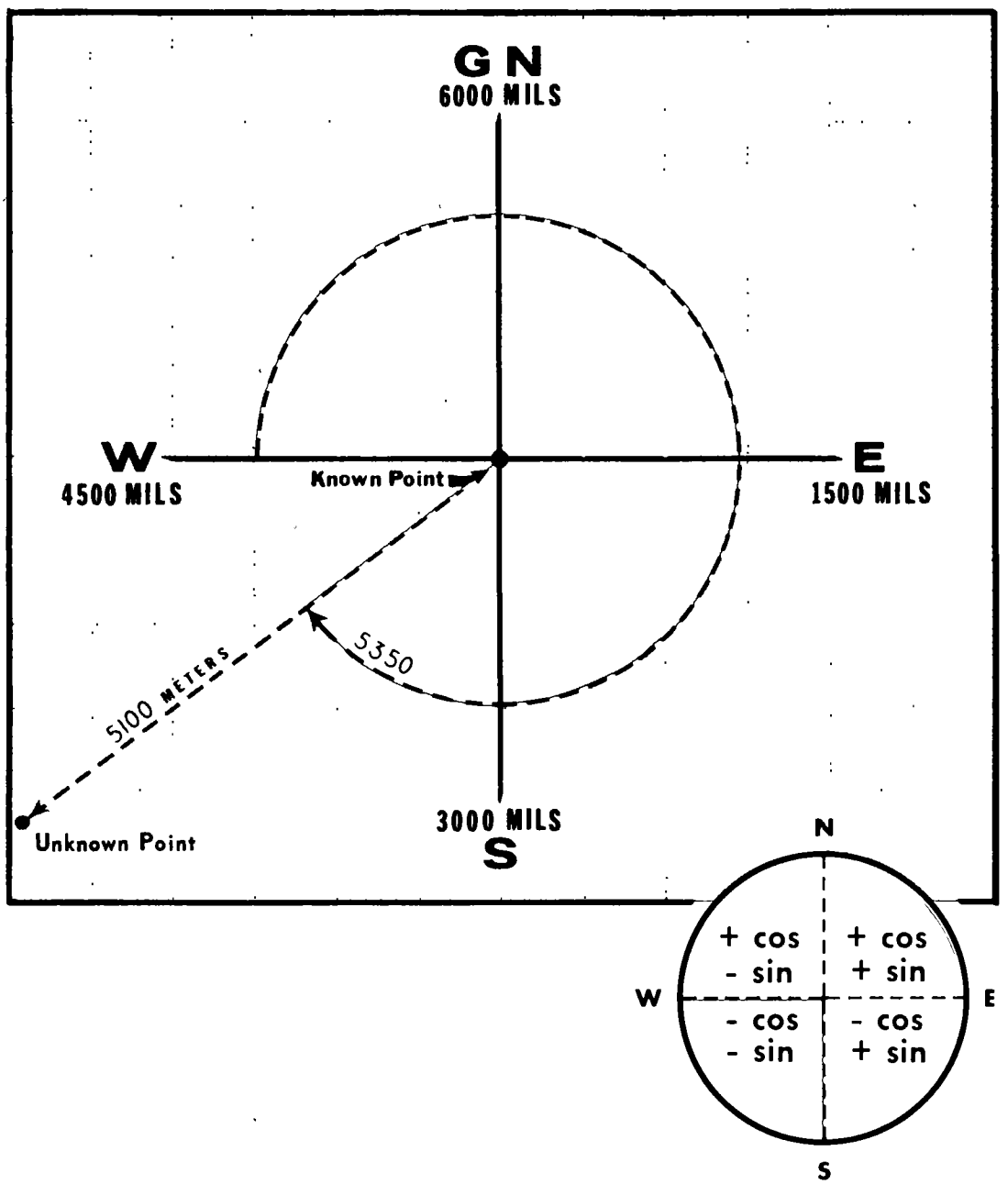
PROBLEM 3

In this example, the GK azimuth is measured clockwise from grid west. Remember - to convert GK polar coordinates to rectangular, the angle must be measured from grid north. Therefore, change mil azimuth to degrees by multiplying by .06; then subtract 90 degrees from the result.

Known Point ● 5826615 2591730

Range (RGE) ● 5100 meters

Mils ● 5350 clockwise from grid west



PROBLEM 3

GIVEN: GK Coordinates 5826615 2591730
RGE 5100 meters
Mils 5350 clockwise from grid west

Northing Formula X unk = X kn + R(COSINEa)

Step 1	Substitute known values.	X unk = 5826615 + 5100 [COSINE (.06 X 5350)]
Step 2	Determine a. (To change mils to degrees, multiply by .06.)	X unk = 5826615 + 5100 [COSINE 321]
Step 3	Subtract 90 from a. (Angle must be clockwise from grid north.)	X unk = 5826615 + 5100 [COSINE 231]
Step 4	Determine COSINE of 231 degrees from appendix G. (The sign is negative as 231 degrees is within the SW quadrant.)	X unk = 5826615 + 5100 [-.6293]
Step 5	Multiply result.	X unk = 5826615 - 3209
Step 6	Add.	X unk = 5823406

Easting Formula Y unk = Y kn + R(SINEa)

Step 1	Substitute known values. (Note: 231 degrees was computed in steps 2/3 above.)	Y unk = 2591730 + 5100 (SINE 231)
Step 2	Determine SINE of 231 degrees from appendix G. (The sign is negative as 231 degrees is within the SW quadrant.)	Y unk = 2591730 + 5100 (-.7771)
Step 3	Multiply result.	Y unk = 2591730 - 3963
Step 4	Add.	Y unk = 2587767

The X unk and Y unk have now been solved and the unknown location is GK coordinates 5823406 2587767.

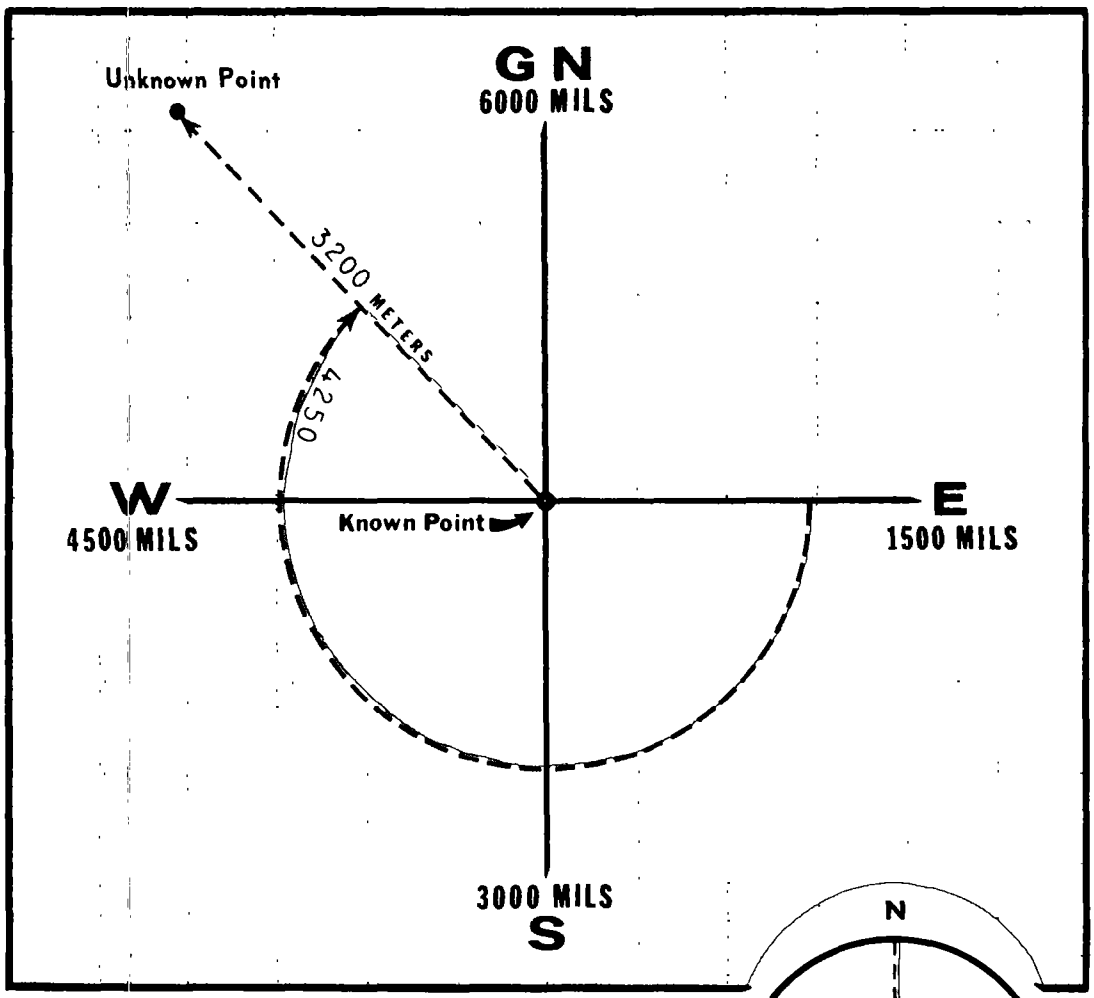
PROBLEM 4

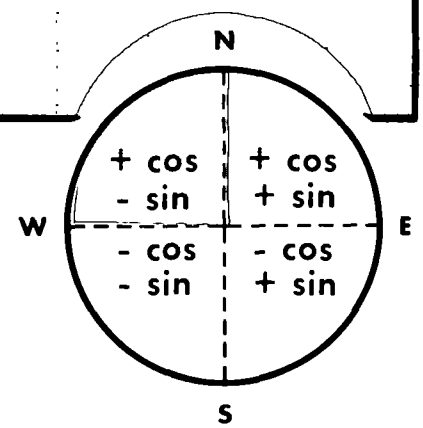
The GK azimuth in problem 4 is measured clockwise from grid east. To convert this azimuth to one from grid north, multiply the azimuth by .06 and then add 90 to the result.

Known Point ● 5826615 2591730

Range (RGE) ● 3200 meters

Mils ● 4250 clockwise from grid east





PROBLEM 4

GIVEN: GK Coordinates 5826615 2591730
RGE 3200 meters
Mils 4250 clockwise from grid east

Northing Formula ○ X unk = X kn + R(COSINEa)

Step 1	Substitute known values.	X unk = 5826615 + 3200 [COSINE (.06 X 4250)]
Step 2	Determine a. (To change mils to degrees, multiply by .06.)	X unk = 5826615 + 3200 [COSINE 255]
Step 3	Add 90 to a. (Angle must be clockwise from grid north.)	X unk = 5826615 + 3200 [COSINE 345]
Step 4	Determine COSINE of 345 degrees from appendix G. (The sign is positive as 345 degrees is within the NW quadrant.)	X unk = 5826615 + 3200 [.9659]
Step 5	Multiply result.	X unk = 5826615 + 3090
Step 6	Add.	X unk = 5829705

Easting Formula ○ Y unk = Y kn + R(SINEa)

Step 1	Substitute known values. (Note: 345 degrees was computed in steps 2/3 above.)	Y unk = 2591730 + 3200 (SINE 345)
Step 2	Determine SINE of 345 degrees from appendix G. The sign is negative as 345 degrees is within the NW quadrant.)	Y unk = 2591730 + 3200 (-.2588)
Step 3	Multiply result.	Y unk = 2591730 - 828
Step 4	Add.	Y unk = 2590902

The X unk and Y unk have now been solved and the unknown location is GK coordinates **5829705 2590902.**

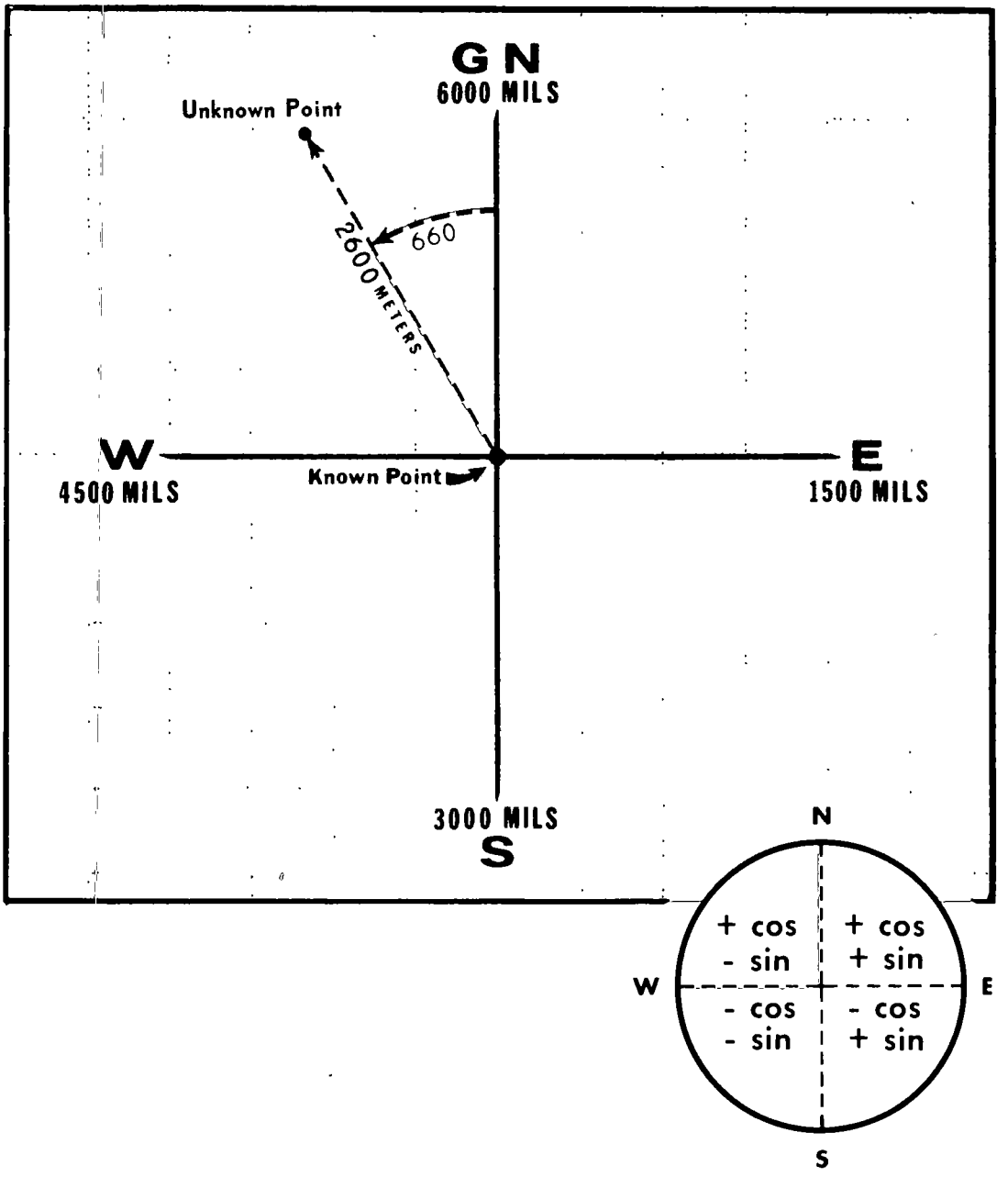
PROBLEM 5

In this final problem, the GK azimuth is measured counterclockwise from grid north. To convert this azimuth to one measured clockwise from grid north, multiply by .06 and subtract from 360.

Known Point ● 5798760 3299500

Range (RGE) ● 2600 meters

Mils ● 660 counterclockwise from grid north



PROBLEM 5

GIVEN: GK Coordinates [redacted] 5798760 3299500
RGE [redacted] 2600 meters
Mils [redacted] 660 counterclockwise from grid north

Northing Formula ● X unk = X kn + R(COSINEa)

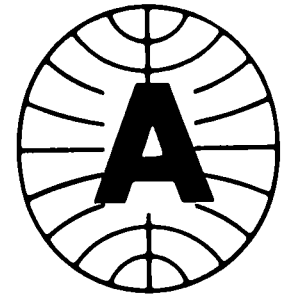
Step 1	Substitute known values.	X unk = 5798760 + 2600 [COSINE (.06 X 660)]
Step 2	Determine a. (To change mils to degrees, multiply by .06.)	X unk = 5798760 + 2600 [COSINE 39.6]
Step 3	Subtract a from 360. (Angle must be clockwise from grid north.)	X unk = 5798760 + 2600 [COSINE 320.4]
Step 4	Determine COSINE of 320.4 degrees from appendix G. (The sign is positive as 320.4 degrees is within the NW quadrant.)	X unk = 5798760 + 2600 [.7705]
Step 5	Multiply result.	X unk = 5798760 + 2003
Step 6	Add.	X unk = 5800763

Easting Formula ● Y unk = Y kn + R(SINEa)

Step 1	Substitute known values. (Note: 320.4 degrees was computed in steps 2/3 above.)	Y unk = 3299500 + 2600 (SINE 320.4)
Step 2	Determine SINE of 320.4 degrees from appendix G. (The sign is negative as 320.4 degrees is within the NW quadrant.)	Y unk = 3299500 + 2600 (-.6374)
Step 3	Multiply result.	Y unk = 3299500 - 1657
Step 4	Add.	Y unk = 3297843

The X unk and Y unk have now been solved and the unknown location is GK coordinates **5800763 3297843.**

Appendix



REFERENCES

- FM 21-26, Map Reading
- DIA-DST-18005-052-Suppl 1 Mapping, Charting, and Geodesy - Eurasian Communist Countries (U), Dec 78, Volume 8 Topographic Mapping (U)

Appendix B

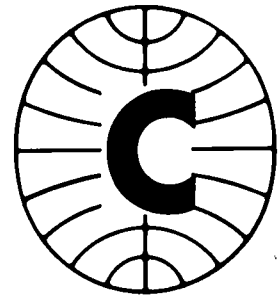
WARSAW PACT MAP

This map insert is a 1:5,000,000 representation of Western Europe and the Warsaw Pact countries. It is divided into Gauss-Krasovskij (GK) zones 1 through 5 and includes the northern portion of Norway. The conversion formulas for each GK zone are located in the margin and each zone has been overlaid with the appropriate UTM 100,000-meter square digraph. The following land area is covered:

GK zone 1 (UTM 31)	42° 00′ to 54° 00′ North latitude 0° 00′ to 6° 00′ East longitude
GK zone 2 (UTM 32)	42° 00′ to 57° 00′ North latitude 6° 00′ to 12° 00′ East longitude
GK zone 3 (UTM 33)	42° 00′ to 57° 00′ North latitude 12° 00′ to 18° 00′ East longitude
GK zone 4 (UTM 34)	40° 00′ to 60° 00′ North latitude 18° 00′ to 24° 00′ East longitude
	69° 00′ to 71° 00′ North latitude 18° 00′ to 24° 00′ East longitude
GK zone 5 (UTM 35)	40° 00′ to 60° 00′ North latitude 24° 00′ to 30° 00′ East longitude
	69° 00′ to 71° 00′ North latitude 24° 00′ to 30° 00′ East longitude

MAP INSERTED IN POCKET OF THE INSIDE BACK COVER !

Appendix



NORTHING AND EASTING GRAPHS

This appendix consists of seven foldouts. Each foldout represents a Gauss-Krasovskij (GK) zone and depicts the appropriate northing and easting graph for that zone.

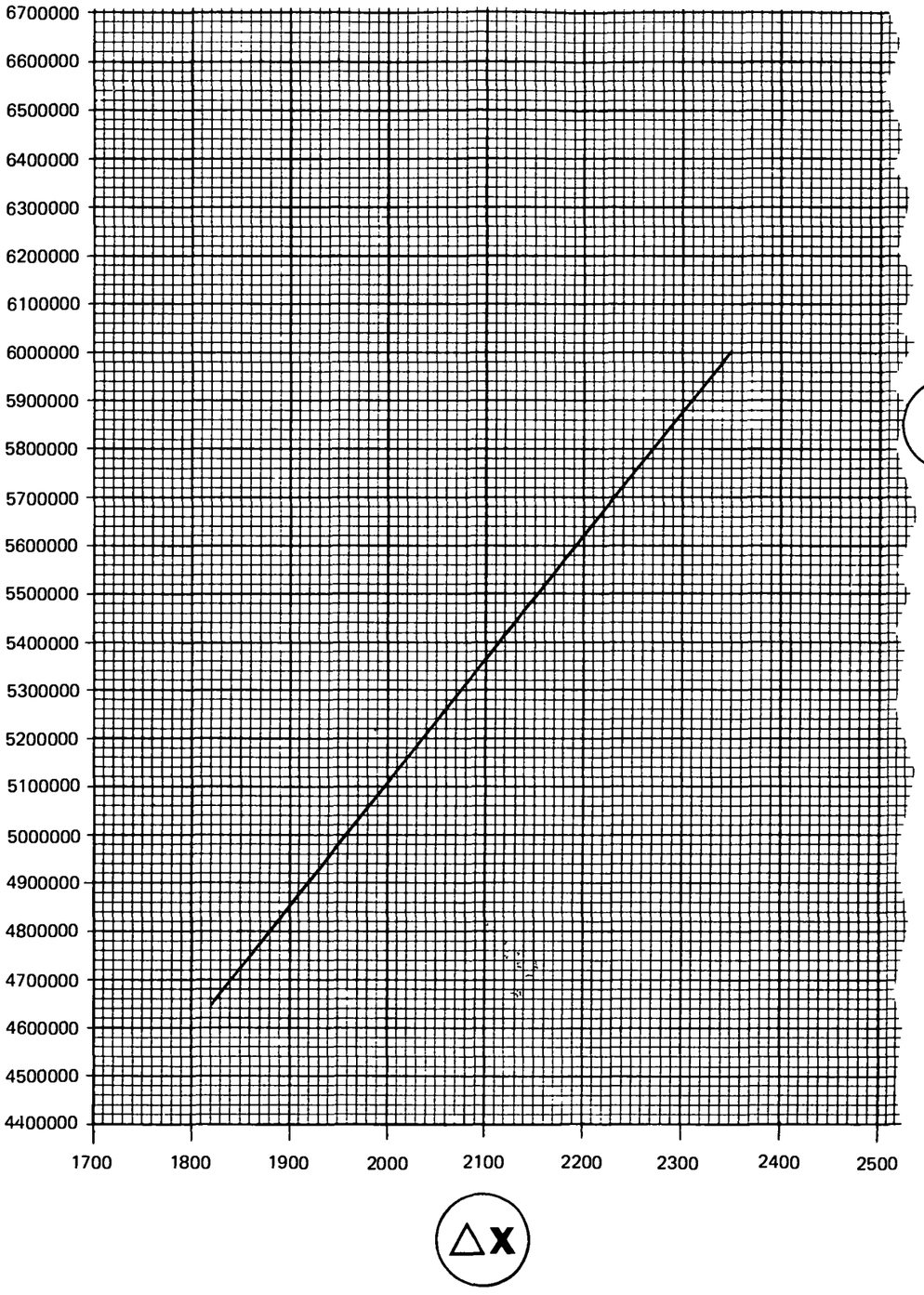
NORTHING GRAPH

N = X − △X

GK ZONE 1

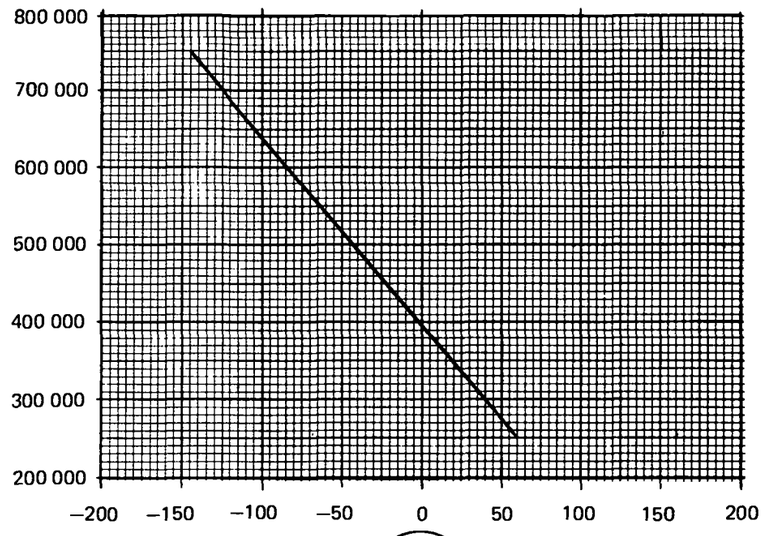
42°00′ to 54°00′
North Latitude

0°00′ to 6°00′
East Longitude



EASTING GRAPH

E = Y + △Y



ZONE 1 FORMULA

NORTHING OR N IS EQUAL TO: **X − △X**

EASTING OR E IS EQUAL TO: **Y + △Y**

WHERE:

X = GK NORTHING (7 DIGITS)

△X = NORTHING DIFFERENCE FROM GRAPH

Y = GK EASTING (6 DIGITS)

△Y = EASTING DIFFERENCE FROM GRAPH

ZONE
1
NORTHING
AND
EASTING
GRAPHS

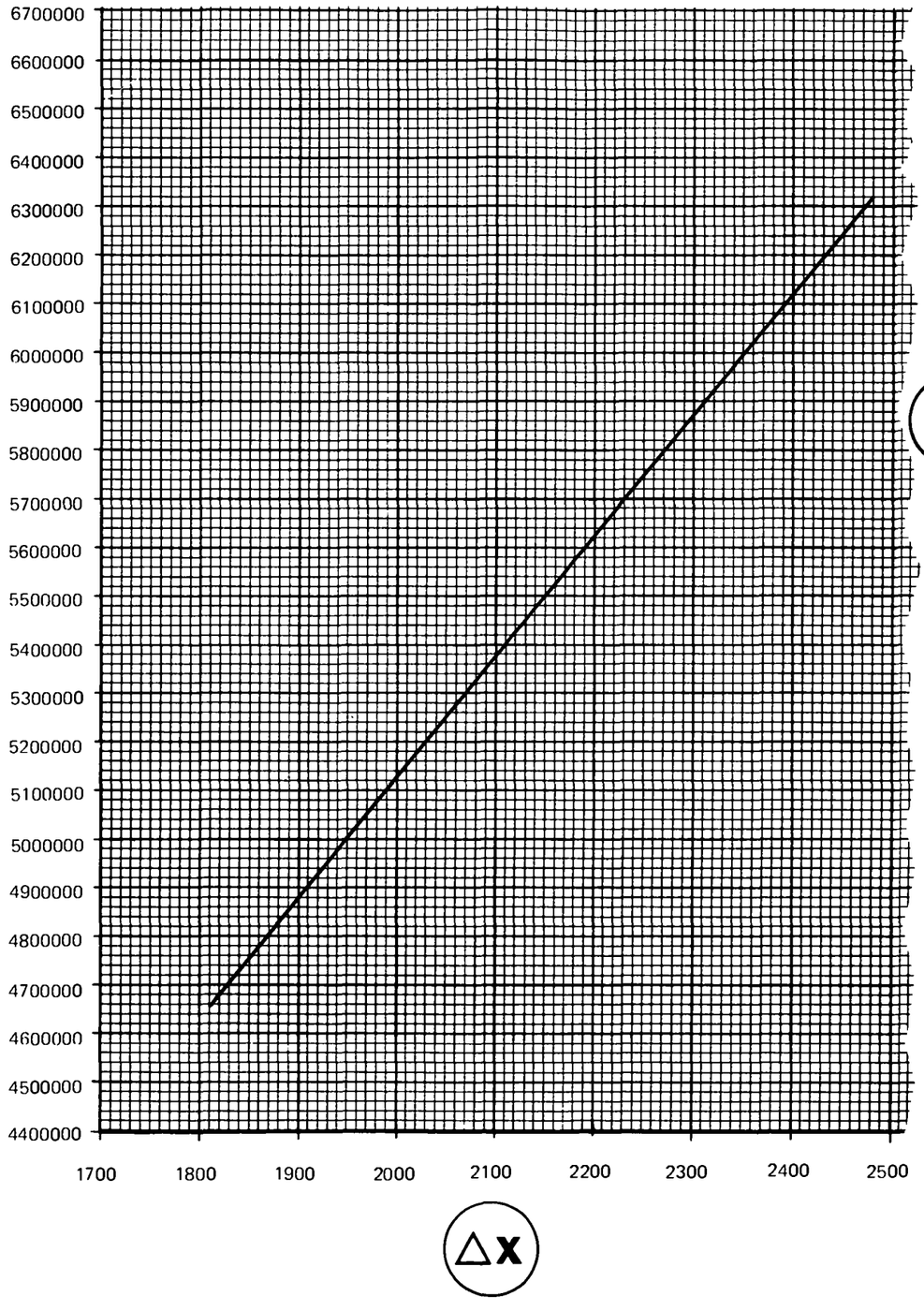
GK ZONE 2

44°00′ to 57°00′
North Latitude

6°00′ to 12°00′
East Longitude

NORTHING GRAPH

N = X − △X



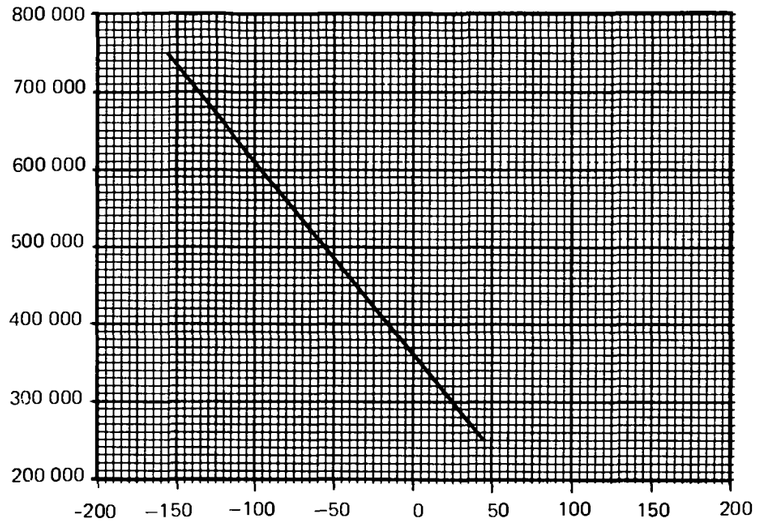
X

△X

Y

EASTING GRAPH

E = Y + △Y



△Y

ZONE 2 FORMULA

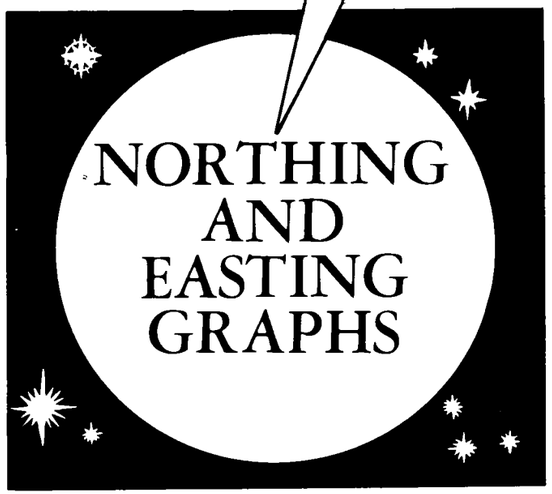
NORTHING OR N IS EQUAL TO: **X − △X**

EASTING OR E IS EQUAL TO: **Y + △Y**

WHERE:

- **X** = GK NORTHING (7 DIGITS)
- **△X** = NORTHING DIFFERENCE FROM GRAPH
- **Y** = GK EASTING (6 DIGITS)
- **△Y** = EASTING DIFFERENCE FROM GRAPH

ZONE 2



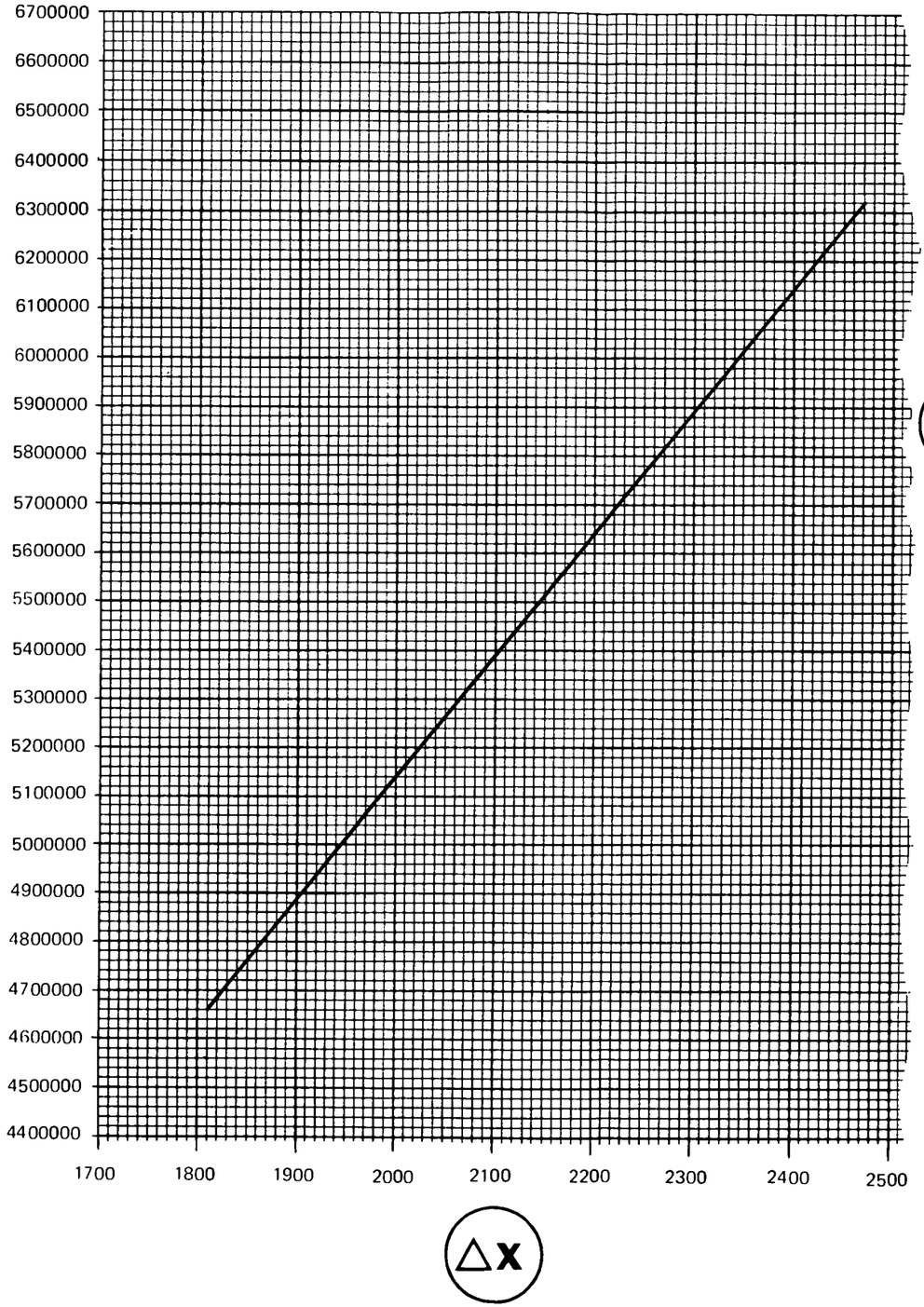
NORTHING GRAPH

N = X − △X

GK ZONE 3

42°00′ to 57°00′
North Latitude

12°00′ to 18°00′
East Longitude



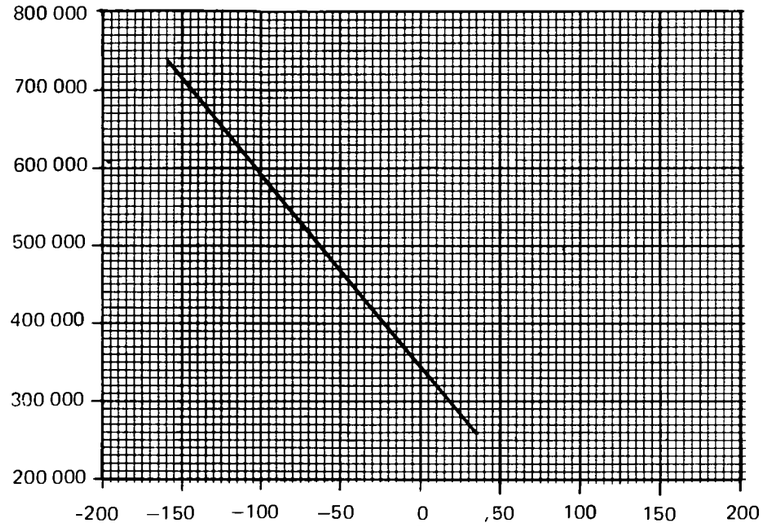
X

△X

Y

EASTING GRAPH

E = Y + △Y



△Y

ZONE 3 FORMULA

NORTHING OR N IS EQUAL TO: **X − △X**

EASTING OR E IS EQUAL TO: **Y + △Y**

WHERE:

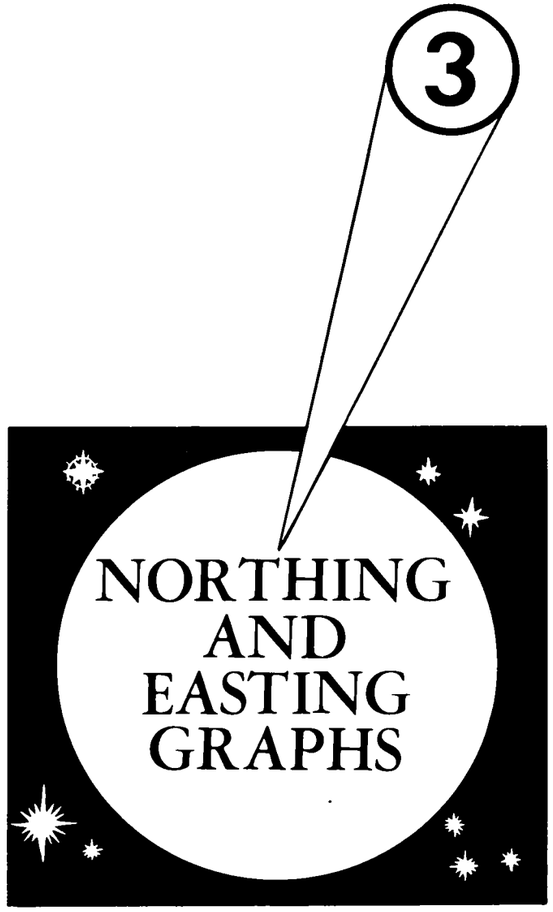
X = GK NORTHING (7 DIGITS)

△X = NORTHING DIFFERENCE FROM GRAPH

Y = GK EASTING (6 DIGITS)

△Y = EASTING DIFFERENCE FROM GRAPH

ZONE 3



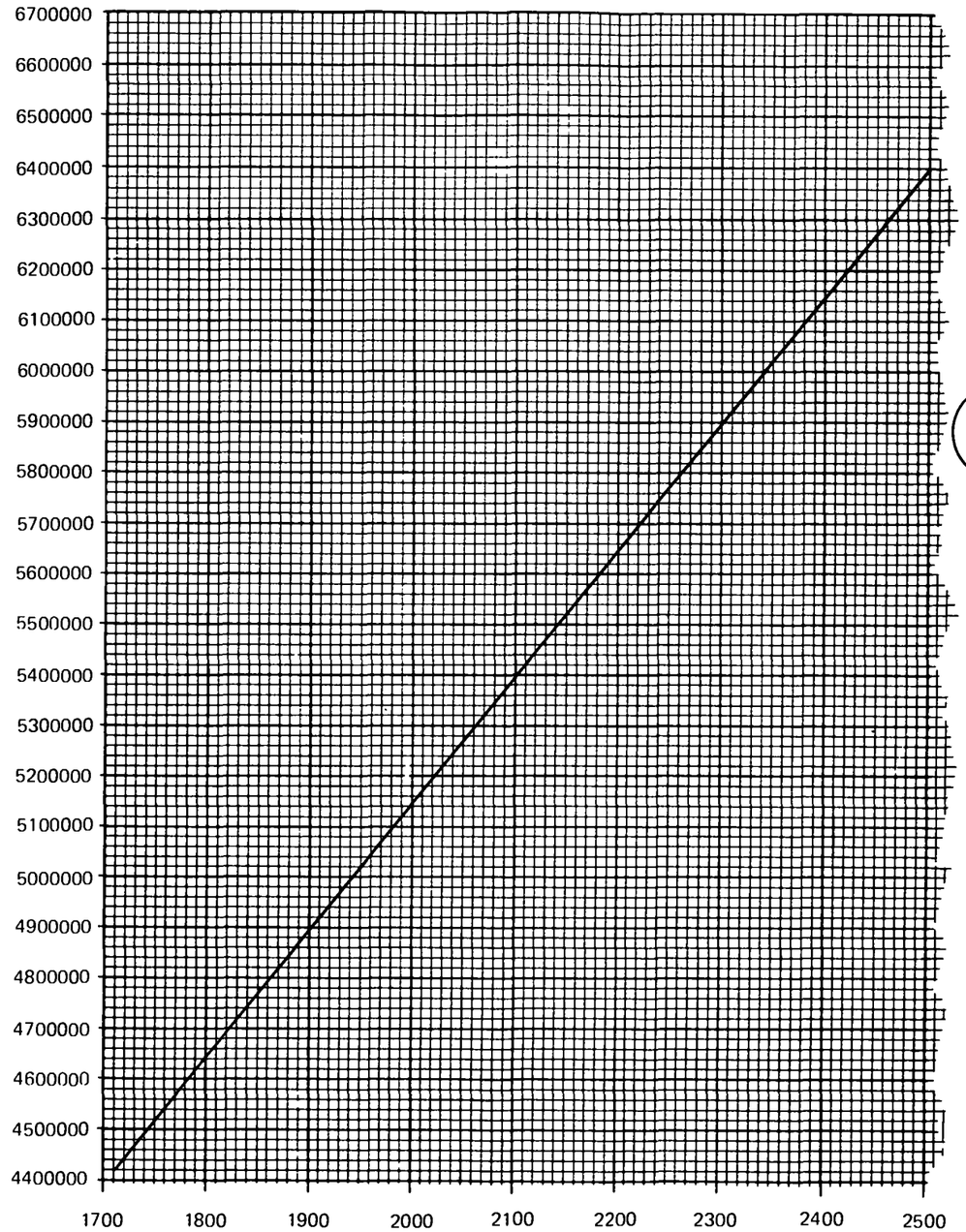
NORTHING GRAPH

N = X − ΔX

GK ZONE 4

40°00′ to 60°00′
North Latitude

18°00′ to 24°00′
East Longitude



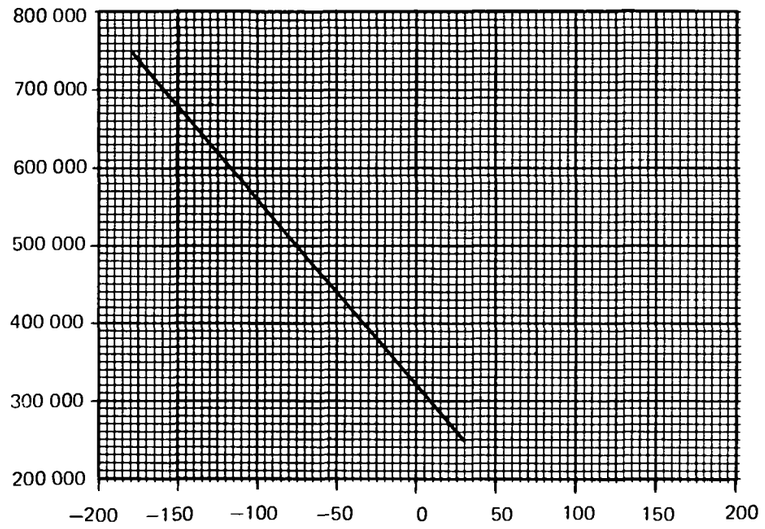
X

ΔX

Y

EASTING GRAPH

E = Y + ΔY



ΔY

ZONE 4 FORMULA

NORTHING OR N IS EQUAL TO: **X − ΔX**

EASTING OR E IS EQUAL TO: **Y + ΔY**

WHERE:

X = GK NORTHING (7 DIGITS)

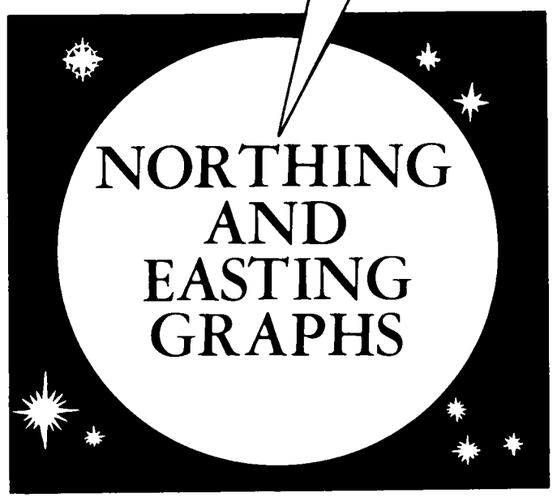
ΔX = NORTHING DIFFERENCE FROM GRAPH

Y = GK EASTING (6 DIGITS)

ΔY = EASTING DIFFERENCE FROM GRAPH

ZONE

4



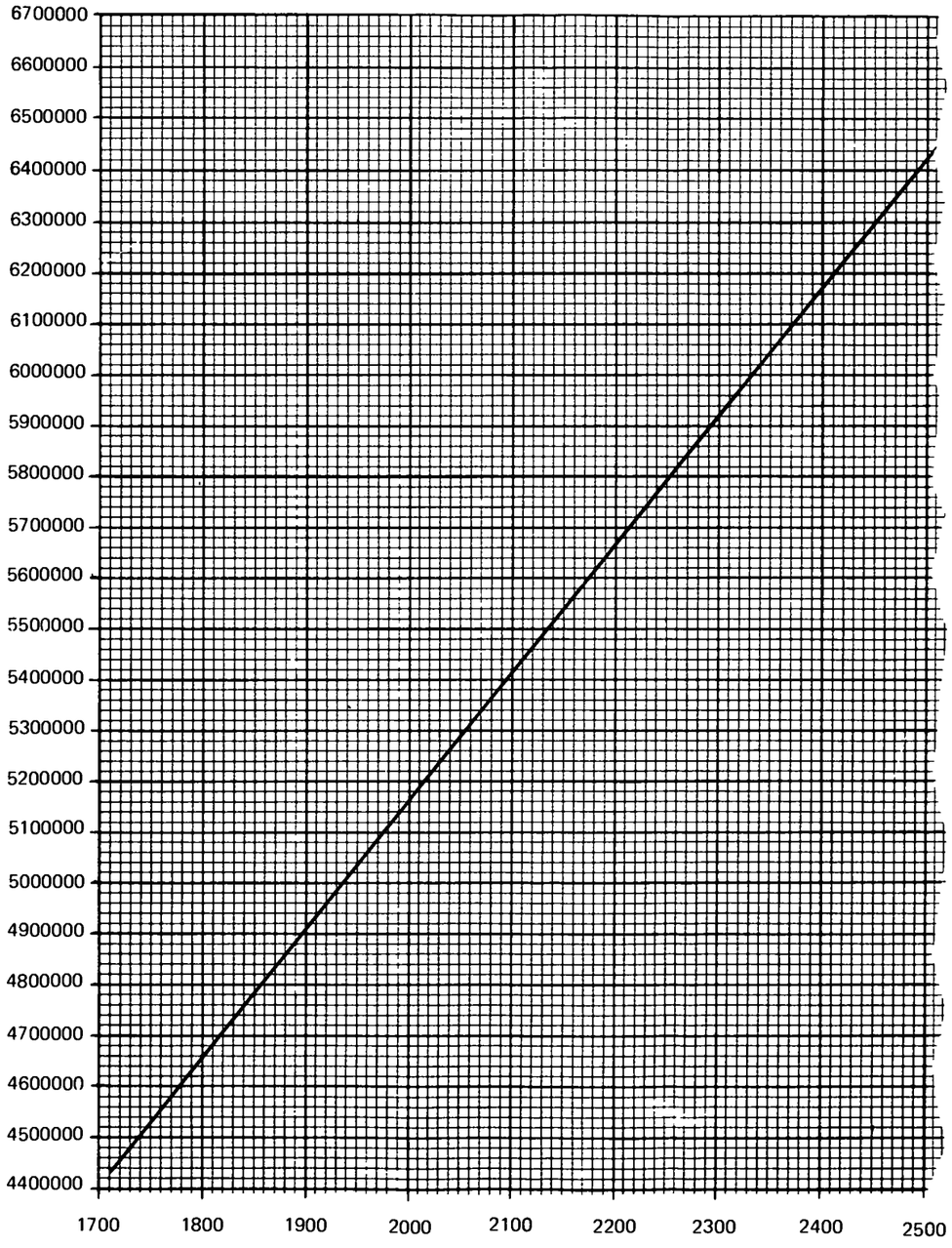
NORTHING GRAPH

N = X − △X

GK ZONE 5

40°00′ to 60°00′
North Latitude

24°00′ to 30°00′
East Longitude

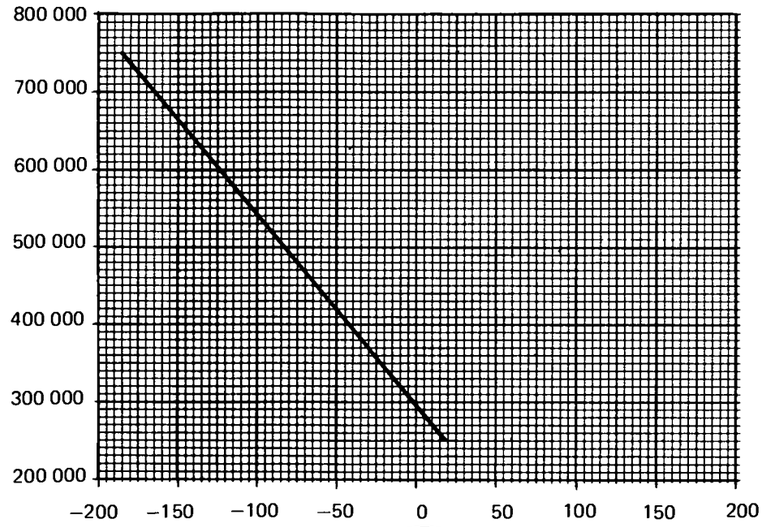


X

△X

EASTING GRAPH

E = Y + △Y



Y

△Y

ZONE 5 FORMULA

NORTHING OR N IS EQUAL TO: **X − △X**

EASTING OR E IS EQUAL TO: **Y + △Y**

WHERE:

X = GK NORTHING (7 DIGITS)

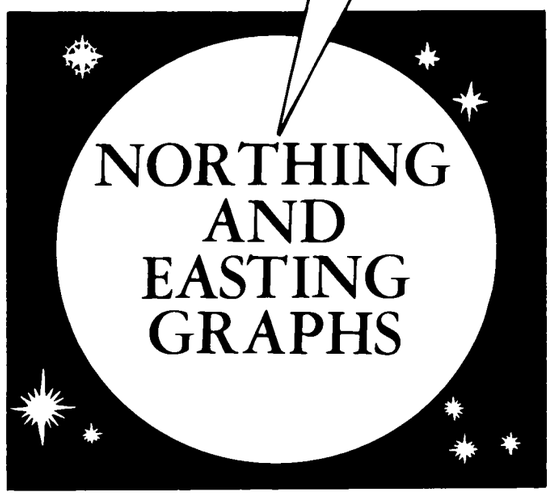
△X = NORTHING DIFFERENCE FROM GRAPH

Y = GK EASTING (6 DIGITS)

△Y = EASTING DIFFERENCE FROM GRAPH

ZONE

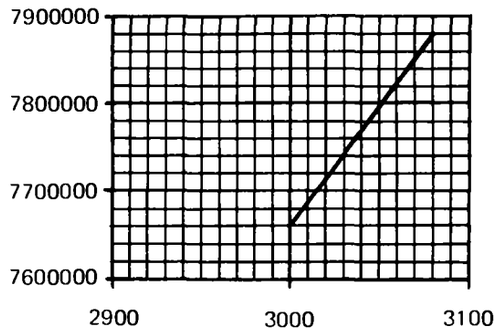
5



Norway

NORTHING GRAPH

N = X − ΔX

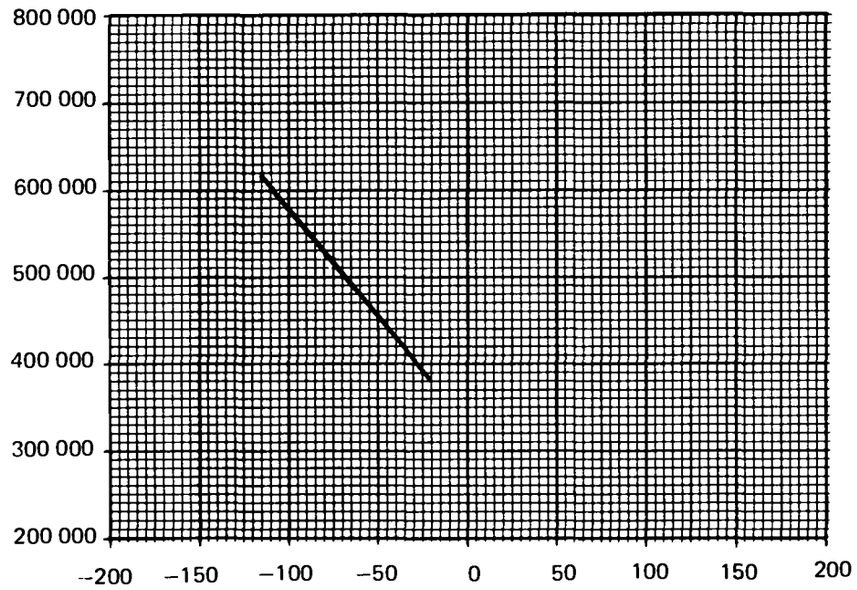


X

ΔX

EASTING GRAPH

E = Y + ΔY



Y

ΔY

GK ZONE 4

69°00′ to 71°00′
North Latitude

18°00′ to 24°00′
East Longitude

ZONE 4 FORMULA

NORTHING OR N IS EQUAL TO: **X − ΔX**

EASTING OR E IS EQUAL TO: **Y + ΔY**

WHERE:

X = GK NORTHING (7 DIGITS)

ΔX = NORTHING DIFFERENCE FROM GRAPH

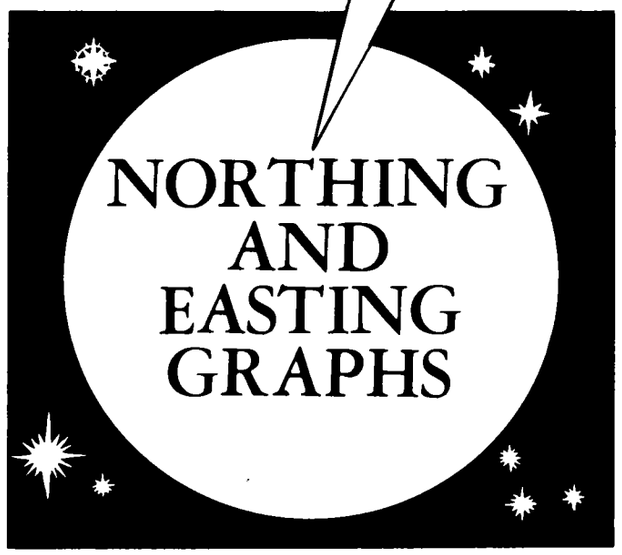
Y = GK EASTING (6 DIGITS)

ΔY = EASTING DIFFERENCE FROM GRAPH

ZONE

4

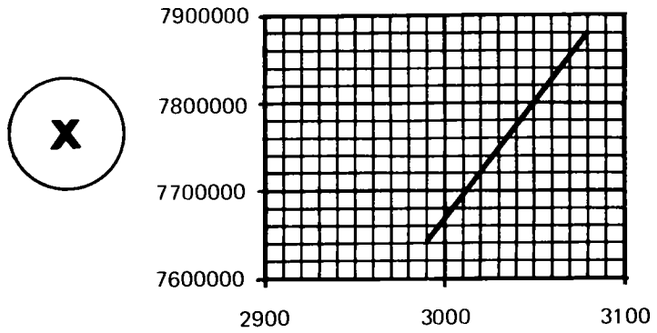
Norway



Norway

NORTHING GRAPH

N = X − △X

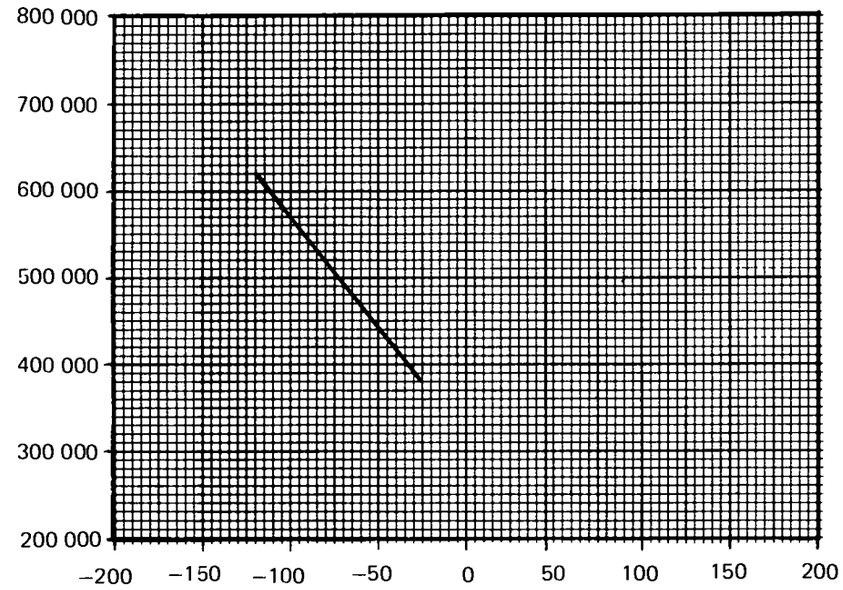


X

△X

EASTING GRAPH

E = Y + △Y



Y

△Y

GK ZONE 5

69°00′ to 71°00′
North Latitude

24°00′ to 30°00′
East Longitude

ZONE 5 FORMULA

NORTHING OR N IS EQUAL TO: **X − △X**

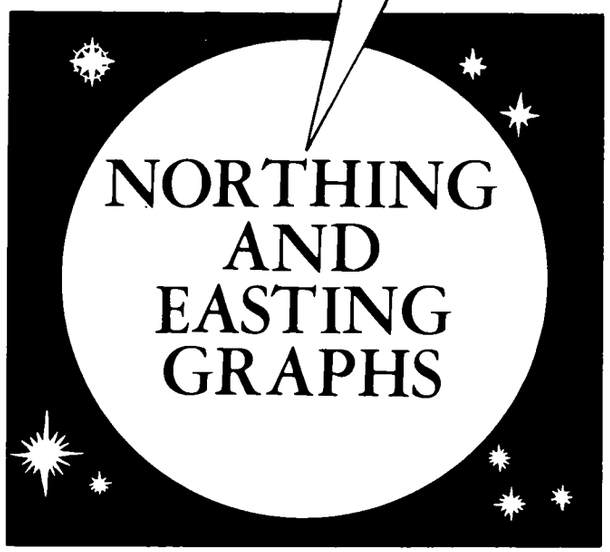
EASTING OR E IS EQUAL TO: **Y + △Y**

WHERE:

- **X** = GK NORTHING (7 DIGITS)
- **△X** = NORTHING DIFFERENCE FROM GRAPH
- **Y** = GK EASTING (6 DIGITS)
- **△Y** = EASTING DIFFERENCE FROM GRAPH

ZONE 5

Norway



Appendix D

NORTHING AND EASTING DIFFERENCE TABLES

This appendix consists of northing (Δ X) and easting (Δ Y) differences for the Warsaw Pact area and adjacent territories.

GK NORTHING 4400000

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
4396751 - 4401250	1713	1706	1705	1699	1693
4401251 - 4403750	1714	1709	1706	1700	1694
4403751 - 4406250	1715	1710	1707	1701	1695
4406251 - 4408750	1716	1711	1706	1702	1696
4408751 - 4411250	1717	1712	1709	1703	1697
4411251 - 4413750	1716	1713	1710	1704	1696
4413751 - 4416250	1719	1714	1711	1705	1699
4416251 - 4416750	1720	1715	1712	1706	1700
4416751 - 4421250	1721	1716	1713	1707	1701
4421251 - 4423750	1722	1717	1714	1706	1702
4423751 - 4426250	1723	1716	1715	1709	1703
4426251 - 4428750	1724	1719	1716	1710	1704
4428751 - 4431250	1725	1720	1717	1711	1705
4431251 - 4433750	1726	1721	1716	1712	1706
4433751 - 4436250	1727	1722	1719	1713	1707
4436251 - 4436750	1726	1723	1720	1714	1706
4438751 - 4441250	1729	1724	1721	1715	1709
4441251 - 4443750	1730	1725	1722	1716	1710
4443751 - 4446250	1731	1726	1723	1717	1711
4446251 - 4448750	1732	1727	1724	1716	1712
4446751 - 4451250	1733	1726	1725	1719	1713
4451251 - 4453750	1734	1729	1726	1720	1714
4453751 - 4456250	1735	1730	1727	1721	1715
4456251 - 4458750	1736	1731	1726	1722	1716
4456751 - 4461250	1737	1732	1729	1723	1717
4461251 - 4463750	1738	1733	1730	1724	1716
4436751 - 4466250	1739	1734	1731	1725	1719
4466251 - 4468750	1740	1735	1732	1726	1720
4468751 - 4471250	1741	1736	1733	1727	1721
4471251 - 4473750	1742	1737	1734	1728	1722
4473751 - 4476250	1743	1738	1735	1729	1723
4476251 - 4478750	1744	1739	1736	1730	1724
4478751 - 4481250	1745	1740	1737	1731	1725
4481251 - 4483750	1746	1741	1738	1732	1726
4483751 - 4486250	1747	1742	1739	1733	1727
4486251 - 4488750	1746	1743	1740	1734	1726
4488751 - 4491250	1749	1744	1741	1735	1729
4491251 - 4493750	1750	1745	1742	1736	1730
4493751 - 4496250	1751	1746	1743	1737	1731
4496251 - 4498750	1752	1747	1744	1736	1732
4498751 - 4501250	1753	1748	1745	1739	1733

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
4498751 - 4501250	1753	1748	1745	1739	1733
4501251 - 4503750	1754	1749	1746	1740	1734
4503751 - 4506250	1755	1750	1747	1741	1735
4506251 - 4508750	1756	1751	1748	1742	1736
4508751 - 4511250	1757	1752	1749	1743	1737
4511251 - 4513750	1758	1753	1750	1744	1738
4513751 - 4516250	1759	1754	1751	1745	1739
4516251 - 4518750	1760	1755	1752	1746	1740
4518751 - 4521250	1761	1756	1753	1747	1741
4521251 - 4523750	1762	1757	1754	1748	1742
4523751 - 4526250	1763	1758	1755	1749	1743
4526251 - 4528750	1764	1759	1756	1750	1744
4528751 - 4531250	1765	1760	1757	1751	1745
4531251 - 4533750	1766	1761	1758	1752	1746
4533751 - 4536250	1767	1762	1759	1753	1747
4536251 - 4538750	1768	1763	1760	1754	1748
4538751 - 4541250	1769	1764	1761	1755	1749
4541251 - 4543750	1770	1765	1762	1756	1750
4543751 - 4546250	1771	1766	1763	1757	1751
4546251 - 4548750	1772	1767	1764	1758	1752
4548751 - 4551250	1773	1768	1765	1759	1753
4551251 - 4553750	1774	1769	1766	1760	1754
4553751 - 4556250	1775	1770	1767	1761	1755
4556251 - 4558750	1776	1771	1768	1762	1756
4558751 - 4561250	1777	1772	1769	1763	1757
4561251 - 4563750	1778	1773	1770	1764	1758
4563751 - 4566250	1779	1774	1771	1765	1759
4566251 - 4568750	1780	1775	1772	1766	1760
4568751 - 4571250	1781	1776	1773	1767	1761
4571251 - 4573750	1782	1777	1774	1768	1762
4573751 - 4576250	1783	1778	1775	1769	1763
4576251 - 4578750	1784	1779	1776	1770	1764
4578751 - 4581250	1785	1780	1777	1771	1765
4581251 - 4583750	1786	1781	1778	1772	1766
4583751 - 4586250	1787	1782	1779	1773	1767
4586251 - 4588750	1788	1783	1780	1774	1768
4588751 - 4591250	1789	1784	1781	1775	1769
4591251 - 4593750	1790	1785	1782	1776	1770
4593751 - 4596250	1791	1786	1783	1777	1771
4596251 - 4598750	1792	1787	1784	1778	1772
4598751 - 4601250	1793	1788	1785	1779	1773

GK NORTHING 4600000

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
4598751 - 4601250	1793	1788	1785	1779	1773
4601251 - 4603750	1794	1789	1786	1780	1774
4603751 - 4606250	1795	1790	1787	1781	1775
4606251 - 4608750	1796	1791	1788	1782	1776
4608751 - 4611250	1797	1792	1789	1783	1777
4611251 - 4613750	1798	1793	1790	1784	1778
4613751 - 4616250	1799	1794	1791	1785	1779
4616251 - 4618750	1800	1795	1792	1786	1780
4618751 - 4621250	1801	1796	1793	1787	1781
4621251 - 4623750	1802	1797	1794	1788	1782
4623751 - 4626250	1803	1798	1795	1789	1783
4626251 - 4628750	1804	1799	1796	1790	1784
4628751 - 4631250	1805	1800	1797	1791	1785
4631251 - 4633750	1806	1801	1798	1792	1786
4633751 - 4636250	1807	1802	1799	1793	1787
4636251 - 4638750	1808	1803	1800	1794	1788
4638751 - 4641250	1809	1804	1801	1795	1789
4641251 - 4643750	1810	1805	1802	1796	1790
4643751 - 4646250	1811	1806	1803	1797	1791
4646251 - 4648750	1812	1807	1804	1798	1792
4648751 - 4651250	1813	1808	1805	1799	1793
4651251 - 4653750	1814	1809	1806	1800	1794
4653751 - 4656250	1815	1810	1807	1801	1795
4656251 - 4658750	1816	1811	1808	1802	1796
4658751 - 4661250	1817	1812	1809	1803	1797
4661251 - 4663750	1818	1813	1810	1804	1798
4663751 - 4666250	1819	1814	1811	1805	1799
4666251 - 4668750	1820	1815	1812	1808	1800
4668751 - 4671250	1821	1816	1813	1807	1801
4671251 - 4673750	1822	1817	1814	1808	1802
4673751 - 4676250	1823	1818	1815	1809	1803
4676251 - 4678750	1824	1819	1818	1810	1804
4678751 - 4681250	1825	1820	1817	1811	1805
4681251 - 4683750	1826	1821	1818	1812	1806
4683751 - 4686250	1827	1822	1819	1813	1807
4686251 - 4688750	1828	1823	1820	1814	1808
4688751 - 4691250	1829	1824	1821	1815	1809
4691251 - 4693750	1830	1825	1822	1818	1810
4693751 - 4696250	1831	1826	1823	1817	1811
4696251 - 4698750	1832	1827	1824	1818	1812
4698751 - 4701250	1833	1828	1825	1819	1813

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
4698751 - 4701250	1833	1828	1825	1819	1813
4701251 - 4703750	1834	1829	1826	1820	1814
4703751 - 4706250	1835	1830	1827	1821	1815
4706251 - 4708750	1836	1831	1828	1822	1816
4708751 - 4711250	1837	1832	1829	1823	1817
4711251 - 4713750	1838	1833	1830	1824	1818
4713751 - 4716250	1839	1834	1831	1825	1819
4716251 - 4718750	1840	1835	1832	1826	1820
4718751 - 4721250	1841	1836	1833	1827	1821
4721251 - 4723750	1842	1837	1834	1828	1822
4723751 - 4726250	1843	1838	1835	1829	1823
4726251 - 4728750	1844	1839	1836	1830	1824
4728751 - 4731250	1845	1840	1837	1831	1825
4731251 - 4733750	1846	1841	1838	1832	1826
4733751 - 4736250	1847	1842	1839	1833	1827
4736251 - 4738750	1848	1843	1840	1834	1828
4738751 - 4741250	1849	1844	1841	1835	1829
4741251 - 4743750	1850	1845	1842	1836	1830
4743751 - 4746250	1851	1846	1843	1837	1831
4746251 - 4748750	1852	1847	1844	1838	1832
4748751 - 4751250	1853	1848	1845	1839	1833
4751251 - 4753750	1854	1849	1846	1840	1834
4753751 - 4756250	1855	1850	1847	1841	1835
4756251 - 4758750	1856	1851	1848	1842	1836
4758751 - 4761250	1857	1852	1849	1843	1837
4761251 - 4763750	1858	1853	1850	1844	1838
4763751 - 4766250	1859	1854	1851	1845	1839
4766251 - 4768750	1860	1855	1852	1848	1840
4768751 - 4771250	1861	1856	1853	1847	1841
4771251 - 4773750	1862	1857	1854	1848	1842
4773751 - 4776250	1863	1858	1855	1849	1843
4776251 - 4778750	1864	1859	1856	1850	1844
4778751 - 4781250	1865	1860	1857	1851	1845
4781251 - 4783750	1866	1861	1858	1852	1846
4783751 - 4786250	1867	1862	1859	1853	1847
4786251 - 4788750	1868	1863	1860	1854	1848
4788751 - 4791250	1869	1864	1861	1855	1849
4791251 - 4793750	1870	1865	1882	1858	1850
4793751 - 4796250	1871	1868	1883	1857	1851
4796251 - 4798750	1872	1867	1864	1858	1852
4798751 - 4801250	1873	1868	1885	1859	1853

GK NORTHING 4800000

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
4798751 - 4801250	1873	1888	1885	1859	1853
4801251 - 4803750	1874	1889	1888	1880	1854
4803751 - 4806250	1875	1870	1887	1861	1855
4806251 - 4808750	1878	1871	1888	1882	1858
4808751 - 4811250	1877	1872	1889	1883	1857
4811251 - 4813750	1878	1873	1870	1884	1858
4813751 - 4816250	1879	1874	1871	1865	1859
4816251 - 4818750	1880	1875	1872	1888	1880
4818751 - 4821250	1881	1878	1873	1887	1881
4821251 - 4823750	1882	1877	1874	1888	1862
4823751 - 4826250	1883	1878	1875	1869	1883
4826251 - 4828750	1884	1879	1878	1870	1864
4828751 - 4831250	1885	1880	1877	1871	1885
4831251 - 4833750	1886	1881	1878	1872	1886
4833751 - 4836250	1887	1882	1879	1873	1887
4836251 - 4838750	1888	1883	1880	1874	1888
4838751 - 4841250	1889	1884	1881	1875	1889
4841251 - 4843750	1890	1885	1882	1878	1870
4843751 - 4846250	1891	1886	1883	1877	1871
4846251 - 4848750	1892	1887	1884	1878	1872
4848751 - 4851250	1893	1888	1885	1879	1873
4851251 - 4853750	1894	1889	1888	1880	1874
4853751 - 4856250	1895	1890	1887	1881	1875
4856251 - 4858750	1896	1891	1888	1882	1876
4858751 - 4861250	1897	1892	1889	1883	1877
4861251 - 4863750	1898	1893	1890	1884	1878
4863751 - 4866250	1899	1894	1891	1885	1879
4866251 - 4868750	1900	1895	1892	1886	1880
4868751 - 4871250	1901	1898	1893	1887	1881
4871251 - 4873750	1902	1897	1894	1888	1882
4873751 - 4876250	1903	1898	1895	1889	1883
4876251 - 4878750	1904	1899	1896	1890	1884
4878751 - 4881250	1905	1900	1897	1891	1885
4881251 - 4883750	1906	1901	1898	1892	1888
4883751 - 4886250	1907	1902	1899	1893	1887
4886251 - 4888750	1908	1903	1900	1894	1888
4888751 - 4891250	1909	1904	1901	1895	1889
4891251 - 4893750	1910	1905	1902	1896	1890
4893751 - 4896250	1911	1908	1903	1897	1891
4896251 - 4898750	1912	1907	1904	1898	1892
4898751 - 4901250	1913	1908	1905	1899	1893

GK NORTHING 4900000

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
4898751 - 4901250	1913	1908	1905	1899	1893
4901251 - 4903750	1914	1909	1906	1900	1894
4903751 - 4906250	1915	1910	1907	1901	1895
4906251 - 4908750	1916	1911	1908	1902	1896
4908751 - 4911250	1917	1912	1909	1903	1897
4911251 - 4913750	1918	1913	1910	1904	1898
4913751 - 4916250	1919	1914	1911	1905	1899
4916251 - 4918750	1920	1915	1912	1906	1900
4918751 - 4921250	1921	1916	1913	1907	1901
4921251 - 4923750	1922	1917	1914	1908	1902
4923751 - 4926250	1923	1918	1915	1909	1903
4926251 - 4928750	1924	1919	1916	1910	1904
4928751 - 4931250	1925	1920	1917	1911	1905
4931251 - 4933750	1926	1921	1918	1912	1906
4933751 - 4936250	1927	1922	1919	1913	1907
4936251 - 4938750	1928	1923	1920	1914	1908
4938751 - 4941250	1929	1924	1921	1915	1909
4941251 - 4943750	1930	1925	1922	1916	1910
4943751 - 4946250	1931	1928	1923	1917	1911
4946251 - 4948750	1932	1927	1924	1918	1912
4948751 - 4951250	1933	1928	1925	1919	1913
4951251 - 4953750	1934	1929	1926	1920	1914
4953751 - 4958250	1935	1930	1927	1921	1915
4956251 - 4958750	1936	1931	1928	1922	1916
4958751 - 4961250	1937	1932	1929	1923	1917
4961251 - 4963750	1938	1933	1930	1924	1918
4963751 - 4988250	1939	1934	1931	1925	1919
4968251 - 4968750	1940	1935	1932	1926	1920
4968751 - 4971250	1941	1936	1933	1927	1921
4971251 - 4973750	1942	1937	1934	1928	1922
4973751 - 4976250	1943	1938	1935	1929	1923
4976251 - 4978750	1944	1939	1938	1930	1924
4978751 - 4981250	1945	1940	1937	1931	1925
4981251 - 4983750	1946	1941	1938	1932	1926
4983751 - 4986250	1947	1942	1939	1933	1927
4988251 - 4988750	1948	1943	1940	1934	1928
4988751 - 4991250	1949	1944	1941	1935	1929
4991251 - 4993750	1950	1945	1942	1936	1930
4993751 - 4996250	1951	1946	1943	1937	1931
4996251 - 4998750	1952	1947	1944	1938	1932
4998751 - 5001250	1953	1948	1945	1939	1933

GK NORTHING 5000000

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
4996751 - 5001250	1953	1946	1945	1939	1933
5001251 - 5003750	1954	1949	1948	1940	1934
5003751 - 5006250	1955	1950	1947	1941	1935
5006251 - 5006750	1956	1951	1948	1942	1936
5008751 - 5011250	1957	1952	1949	1943	1937
5011251 - 5013750	1956	1953	1950	1944	1938
5013751 - 5016250	1959	1954	1951	1945	1939
5016251 - 5018750	1960	1955	1952	1946	1940
5018751 - 5021250	1961	1956	1953	1947	1941
5021251 - 5023750	1962	1957	1954	1948	1942
5023751 - 5026250	1963	1956	1955	1949	1943
5026251 - 5028750	1964	1959	1956	1950	1944
5026751 - 5031250	1965	1960	1957	1951	1945
5031251 - 5033750	1986	1961	1958	1952	1946
5033751 - 5036250	1967	1962	1959	1953	1947
5036251 - 5038750	1968	1963	1960	1954	1948
5038751 - 5041250	1969	1964	1961	1955	1949
5041251 - 5043750	1970	1965	1962	1956	1950
5043751 - 5046250	1971	1966	1983	1957	1951
5046251 - 5048750	1972	1967	1964	1958	1952
5048751 - 5051250	1973	1988	1965	1959	1953
5051251 - 5053750	1974	1989	1986	1960	1954
5053751 - 5056250	1975	1970	1967	1961	1955
5056251 - 5058750	1978	1971	1986	1962	1956
5058751 - 5061250	1977	1972	1969	1963	1957
5061251 - 5063750	1976	1973	1970	1964	1958
5063751 - 5066250	1979	1974	1971	1965	1959
5066251 - 5068750	1960	1975	1972	1986	1960
5068751 - 5071250	1981	1976	1973	1967	1961
5071251 - 5073750	1982	1977	1974	1988	1962
5073751 - 5076250	1983	1978	1975	1969	1963
5076251 - 5078750	1964	1979	1976	1970	1984
5078751 - 5081250	1985	1960	1977	1971	1965
5081251 - 5063750	1986	1981	1978	1972	1968
5083751 - 5086250	1987	1982	1979	1973	1987
5086251 - 5088750	1988	1983	1960	1974	1966
5068751 - 5091250	1989	1984	1981	1975	1989
5091251 - 5093750	1990	1985	1982	1976	1970
5093751 - 5098250	1991	1986	1963	1977	1971
5096251 - 5098750	1992	1967	1984	1976	1972
5098751 - 5101250	1993	1968	1965	1979	1973

GK NORTHING 5100000

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
5098751 - 5101250	1993	1988	1985	1979	1973
5101251 - 5103750	1994	1989	1986	1980	1974
5103751 - 5106250	1995	1990	1987	1981	1975
5106251 - 5108750	1996	1991	1988	1982	1976
5108751 - 5111250	1997	1992	1989	1983	1977
5111251 - 5113750	1998	1993	1990	1984	1978
5113751 - 5116250	1999	1994	1991	1985	1979
5116251 - 5118750	2000	1995	1992	1986	1980
5118751 - 5121250	2001	1996	1993	1987	1981
5121251 - 5123750	2002	1997	1994	1988	1982
5123751 - 5126250	2003	1998	1995	1989	1983
5126251 - 5128750	2004	1999	1996	1990	1984
5128751 - 5131250	2005	2000	1997	1991	1985
5131251 - 5133750	2006	2001	1998	1992	1986
5133751 - 5136250	2007	2002	1999	1993	1987
5136251 - 5138750	2008	2003	2000	1994	1988
5138751 - 5141250	2009	2004	2001	1995	1989
5141251 - 5143750	2010	2005	2002	1996	1990
5143751 - 5146250	2011	2006	2003	1997	1991
5146251 - 5148750	2012	2007	2004	1998	1992
5148751 - 5151250	2013	2008	2005	1999	1993
5151251 - 5153750	2014	2009	2006	2000	1994
5153751 - 5156250	2015	2010	2007	2001	1995
5156251 - 5158750	2016	2011	2008	2002	1996
5158751 - 5161250	2017	2012	2009	2003	1997
5161251 - 5163750	2018	2013	2010	2004	1998
5163751 - 5166250	2019	2014	2011	2005	1999
5166251 - 5168750	2020	2015	2012	2006	2000
5168751 - 5171250	2021	2016	2013	2007	2001
5171251 - 5173750	2022	2017	2014	2008	2002
5173751 - 5176250	2023	2018	2015	2009	2003
5176251 - 5178750	2024	2019	2016	2010	2004
5178751 - 5181250	2025	2020	2017	2011	2005
5181251 - 5183750	2026	2021	2018	2012	2006
5183751 - 5186250	2027	2022	2019	2013	2007
5186251 - 5188750	2028	2023	2020	2014	2008
5188751 - 5191250	2029	2024	2021	2015	2009
5191251 - 5193750	2030	2025	2022	2016	2010
5193751 - 5196250	2031	2026	2023	2017	2011
5196251 - 5198750	2032	2027	2024	2018	2012
5198751 - 5201250	2033	2028	2025	2019	2013

GK NORTHING 5200000

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
5198751 - 5201250	2033	2028	2025	2019	2013
5201251 - 5203750	2034	2029	2028	2020	2014
5203751 - 5206250	2035	2030	2027	2021	2015
5206251 - 5208750	2038	2031	2028	2022	2018
5206751 - 5211250	2037	2032	2029	2023	2017
5211251 - 5213750	2038	2033	2030	2024	2018
5213751 - 5216250	2039	2034	2031	2025	2019
5216251 - 5218750	2040	2035	2032	2026	2020
5216751 - 5221250	2041	2036	2033	2027	2021
5221251 - 5223750	2042	2037	2034	2028	2022
5223751 - 5226250	2043	2038	2035	2029	2023
5226251 - 5226750	2044	2039	2038	2030	2024
5226751 - 5231250	2045	2040	2037	2031	2025
5231251 - 5233750	2046	2041	2038	2032	2026
5233751 - 5236250	2047	2042	2039	2033	2027
5236251 - 5238750	2046	2043	2040	2034	2028
5238751 - 5241250	2049	2044	2041	2035	2029
5241251 - 5243750	2050	2045	2042	2036	2030
5243751 - 5246250	2051	2046	2043	2037	2031
5246251 - 5248750	2052	2047	2044	2038	2032
5246751 - 5251250	2053	2048	2045	2039	2033
5251251 - 5253750	2054	2049	2048	2040	2034
5253751 - 5256250	2055	2050	2047	2041	2035
5256251 - 5256750	2058	2051	2048	2042	2036
5256751 - 5261250	2057	2052	2049	2043	2037
5261251 - 5263750	2056	2053	2050	2044	2038
5263751 - 5268250	2059	2054	2051	2045	2039
5266251 - 5288750	2080	2055	2052	2048	2040
5266751 - 5271250	2061	2056	2053	2047	2041
5271251 - 5273750	2062	2057	2054	2048	2042
5273751 - 5276250	2063	2058	2055	2049	2043
5276251 - 5278750	2064	2059	2056	2050	2044
5276751 - 5261250	2065	2080	2057	2051	2045
5261251 - 5263750	2068	2061	2058	2052	2048
5263751 - 5286250	2087	2082	2059	2053	2047
5266251 - 5266750	2086	2083	2080	2054	2046
5266751 - 5291250	2089	2064	2081	2055	2049
5291251 - 5293750	2070	2085	2062	2058	2050
5293751 - 5296250	2071	2068	2063	2057	2051
5296251 - 5298750	2072	2087	2084	2056	2052
5296751 - 5301250	2073	2088	2065	2059	2053

GK NORTHING 5300000

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
5298751 - 5301250	2073	2068	2065	2059	2053
5301251 - 5303750	2074	2069	2068	2060	2054
5303751 - 5306250	2075	2070	2067	2061	2055
5306251 - 5308750	2076	2071	2088	2062	2056
5308751 - 5311250	2077	2072	2069	2063	2057
5311251 - 5313750	2078	2073	2070	2084	2058
5313751 - 5316250	2079	2074	2071	2085	2059
5316251 - 5318750	2080	2075	2072	2088	2060
5318751 - 5321250	2081	2076	2073	2087	2081
5321251 - 5323750	2082	2077	2074	2088	2082
5323751 - 5326250	2083	2078	2075	2089	2083
5326251 - 5328750	2084	2079	2078	2070	2064
5328751 - 5331250	2085	2080	2077	2071	2065
5331251 - 5333750	2086	2081	2078	2072	2086
5333751 - 5336250	2087	2082	2079	2073	2087
5336251 - 5338750	2088	2083	2080	2074	2088
5338751 - 5341250	2089	2084	2081	2075	2069
5341251 - 5343750	2090	2085	2082	2078	2070
5343751 - 5346250	2091	2086	2083	2077	2071
5346251 - 5348750	2092	2087	2084	2078	2072
5348751 - 5351250	2093	2088	2085	2079	2073
5351251 - 5353750	2094	2089	2088	2080	2074
5353751 - 5356250	2095	2090	2087	2081	2075
5356251 - 5358750	2096	2091	2088	2082	2076
5358751 - 5361250	2097	2092	2089	2083	2077
5361251 - 5363750	2098	2093	2090	2084	2078
5363751 - 5366250	2099	2094	2091	2085	2079
5366251 - 5368750	2100	2095	2092	2088	2080
5368751 - 5371250	2101	2098	2093	2087	2081
5371251 - 5373750	2102	2097	2094	2088	2082
5373751 - 5376250	2103	2098	2095	2089	2083
5376251 - 5378750	2104	2099	2098	2090	2084
5378751 - 5381250	2105	2100	2097	2091	2085
5381251 - 5383750	2106	2101	2098	2092	2086
5383751 - 5386250	2107	2102	2099	2093	2087
5386251 - 5388750	2108	2103	2100	2094	2088
5388751 - 5391250	2109	2104	2101	2095	2089
5391251 - 5393750	2110	2105	2102	2098	2090
5393751 - 5396250	2111	2108	2103	2097	2091
5396251 - 5398750	2112	2107	2104	2098	2092
5398751 - 5401250	2113	2108	2105	2099	2093

GK NORTHING 5400000

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
5398751 - 5401250	2113	2108	2105	2099	2093
5401251 - 5403750	2114	2109	2106	2100	2094
5403751 - 5406250	2115	2110	2107	2101	2095
5406251 - 5408750	2116	2111	2108	2102	2096
5408751 - 5411250	2117	2112	2109	2103	2097
5411251 - 5413750	2118	2113	2110	2104	2098
5413751 - 5416250	2119	2114	2111	2105	2099
5416251 - 5418750	2120	2115	2112	2106	2100
5418751 - 5421250	2121	2116	2113	2107	2101
5421251 - 5423750	2122	2117	2114	2108	2102
5423751 - 5426250	2123	2118	2115	2109	2103
5426251 - 5428750	2124	2119	2116	2110	2104
5428751 - 5431250	2125	2120	2117	2111	2105
5431251 - 5433750	2126	2121	2118	2112	2106
5433751 - 5436250	2127	2122	2119	2113	2107
5436251 - 5438750	2128	2123	2120	2114	2108
5438751 - 5441250	2129	2124	2121	2115	2109
5441251 - 5443750	2130	2125	2122	2116	2110
5443751 - 5446250	2131	2126	2123	2117	2111
5446251 - 5448750	2132	2127	2124	2118	2112
5448751 - 5451250	2133	2128	2125	2119	2113
5451251 - 5453750	2134	2129	2126	2120	2114
5453751 - 5456250	2135	2130	2127	2121	2115
5456251 - 5458750	2136	2131	2128	2122	2116
5458751 - 5461250	2137	2132	2129	2123	2117
5461251 - 5463750	2138	2133	2130	2124	2118
5463751 - 5466250	2139	2134	2131	2125	2119
5466251 - 5468750	2140	2135	2132	2126	2120
5468751 - 5471250	2141	2136	2133	2127	2121
5471251 - 5473750	2142	2137	2134	2128	2122
5473751 - 5476250	2143	2138	2135	2129	2123
5476251 - 5478750	2144	2139	2136	2130	2124
5478751 - 5481250	2145	2140	2137	2131	2125
5481251 - 5483750	2146	2141	2138	2132	2126
5483751 - 5486250	2147	2142	2139	2133	2127
5486251 - 5488750	2148	2143	2140	2134	2128
5488751 - 5491250	2149	2144	2141	2135	2129
5491251 - 5493750	2150	2145	2142	2136	2130
5493751 - 5496250	2151	2146	2143	2137	2131
5496251 - 5498750	2152	2147	2144	2138	2132
5498751 - 5501250	2153	2148	2145	2139	2133

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
5498751 - 5501250	2153	2148	2145	2139	2133
5501251 - 5503750	2154	2149	2146	2140	2134
5503751 - 5506250	2155	2150	2147	2141	2135
5506251 - 5508750	2156	2151	2148	2142	2138
5508751 - 5511250	2157	2152	2149	2143	2137
5511251 - 5513750	2158	2153	2150	2144	2138
5513751 - 5516250	2159	2154	2151	2145	2139
5516251 - 5518750	2160	2155	2152	2148	2140
5518751 - 5521250	2161	2156	2153	2147	2141
5521251 - 5523750	2162	2157	2154	2148	2142
5523751 - 5526250	2183	2158	2155	2149	2143
5526251 - 5528750	2164	2159	2158	2150	2144
5528751 - 5531250	2185	2160	2157	2151	2145
5531251 - 5533750	2186	2181	2158	2152	2148
5533751 - 5536250	2167	2182	2159	2153	2147
5536251 - 5538750	2168	2183	2180	2154	2148
5538751 - 5541250	2169	2164	2181	2155	2149
5541251 - 5543750	2170	2165	2162	2158	2150
5543751 - 5546250	2171	2188	2183	2157	2151
5546251 - 5548750	2172	2187	2184	2158	2152
5548751 - 5551250	2173	2168	2165	2159	2153
5551251 - 5553750	2174	2169	2188	2180	2154
5553751 - 5556250	2175	2170	2187	2161	2155
5556251 - 5558750	2176	2171	2188	2182	2156
5558751 - 5561250	2177	2172	2169	2183	2157
5561251 - 5563750	2178	2173	2170	2184	2158
5563751 - 5566250	2179	2174	2171	2185	2159
5566251 - 5568750	2180	2175	2172	2188	2160
5568751 - 5571250	2181	2176	2173	2187	2161
5571251 - 5573750	2182	2177	2174	2188	2162
5573751 - 5576250	2183	2178	2175	2169	2183
5576251 - 5578750	2184	2179	2178	2170	2164
5578751 - 5581250	2185	2180	2177	2171	2185
5581251 - 5583750	2186	2181	2178	2172	2186
5583751 - 5586250	2187	2182	2179	2173	2187
5586251 - 5588750	2188	2183	2180	2174	2168
5588751 - 5591250	2189	2184	2181	2175	2189
5591251 - 5593750	2190	2185	2182	2176	2170
5593751 - 5596250	2191	2188	2183	2177	2171
5596251 - 5598750	2192	2187	2184	2178	2172
5598751 - 5601250	2193	2188	2185	2179	2173

GK NORTHING 5600000

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
5598751 - 5601250	2193	2188	2185	2179	2173
5601251 - 5603750	2194	2189	2188	2180	2174
5603751 - 5606250	2195	2190	2187	2181	2175
5606251 - 5608750	2196	2191	2188	2182	2176
5608751 - 5611250	2197	2192	2189	2183	2177
5611251 - 5613750	2198	2193	2190	2184	2178
5613751 - 5616250	2199	2194	2191	2185	2179
5616251 - 5618750	2200	2195	2192	2188	2180
5618751 - 5621250	2201	2198	2193	2187	2181
5621251 - 5623750	2202	2197	2194	2188	2182
5623751 - 5626250	2203	2198	2195	2189	2183
5626251 - 5628750	2204	2199	2198	2190	2184
5628751 - 5631250	2205	2200	2197	2191	2185
5631251 - 5833750	2206	2201	2198	2192	2186
5633751 - 5636250	2207	2202	2199	2193	2187
5636251 - 5638750	2208	2203	2200	2194	2188
5638751 - 5641250	2209	2204	2201	2195	2189
5641251 - 5643750	2210	2205	2202	2198	2190
5643751 - 5648250	2211	2208	2203	2197	2191
5646251 - 5648750	2212	2207	2204	2198	2192
5648751 - 5651250	2213	2208	2205	2199	2193
5651251 - 5653750	2214	2209	2208	2200	2194
5653751 - 5656250	2215	2210	2207	2201	2195
5656251 - 5658750	2218	2211	2208	2202	2198
5658751 - 5661250	2217	2212	2209	2203	2197
5661251 - 5663750	2218	2213	2210	2204	2198
5663751 - 5666250	2219	2214	2211	2205	2199
5666251 - 5668750	2220	2215	2212	2208	2200
5668751 - 5671250	2221	2216	2213	2207	2201
5671251 - 5673750	2222	2217	2214	2208	2202
5673751 - 5676250	2223	2218	2215	2209	2203
5676251 - 5678750	2224	2219	2218	2210	2204
5678751 - 5881250	2225	2220	2217	2211	2205
5681251 - 5683750	2228	2221	2218	2212	2208
5683751 - 5686250	2227	2222	2219	2213	2207
5686251 - 5688750	2228	2223	2220	2214	2208
5688751 - 5691250	2229	2224	2221	2215	2209
5691251 - 5693750	2230	2225	2222	2218	2210
5693751 - 5696250	2231	2226	2223	2217	2211
5696251 - 5698750	2232	2227	2224	2218	2212
5698751 - 5701250	2233	2228	2225	2219	2213

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
5698751 - 5701250	2233	2228	2225	2219	2213
5701251 - 5703750	2234	2229	2226	2220	2214
5703751 - 5706250	2235	2230	2227	2221	2215
5706251 - 5708750	2236	2231	2228	2222	2216
5708751 - 5711250	2237	2232	2229	2223	2217
5711251 - 5713750	2238	2233	2230	2224	2218
5713751 - 5716250	2239	2234	2231	2225	2219
5716251 - 5718750	2240	2235	2232	2228	2220
5718751 - 5721250	2241	2238	2233	2227	2221
5721251 - 5723750	2242	2237	2234	2228	2222
5723751 - 5726250	2243	2238	2235	2229	2223
5726251 - 5728750	2244	2239	2238	2230	2224
5728751 - 5731250	2245	2240	2237	2231	2225
5731251 - 5733750	2248	2241	2238	2232	2226
5733751 - 5736250	2247	2242	2239	2233	2227
5736251 - 5738750	2248	2243	2240	2234	2228
5738751 - 5741250	2249	2244	2241	2235	2229
5741251 - 5743750	2250	2245	2242	2238	2230
5743751 - 5746250	2251	2246	2243	2237	2231
5746251 - 5748750	2252	2247	2244	2238	2232
5748751 - 5751250	2253	2248	2245	2239	2233
5751251 - 5753750	2254	2249	2246	2240	2234
5753751 - 5756250	2255	2250	2247	2241	2235
5756251 - 5758750	2256	2251	2248	2242	2238
5758751 - 5761250	2257	2252	2249	2243	2237
5761251 - 5763750	2258	2253	2250	2244	2238
5763751 - 5766250	2259	2254	2251	2245	2239
5766251 - 5768750	2280	2255	2252	2248	2240
5768751 - 5771250	2261	2258	2253	2247	2241
5771251 - 5773750	2262	2257	2254	2248	2242
5773751 - 5778250	2263	2258	2255	2249	2243
5776251 - 5778750	2264	2259	2258	2250	2244
5778751 - 5781250	2285	2280	2257	2251	2245
5781251 - 5783750	2266	2281	2258	2252	2248
5783751 - 5788250	2287	2282	2259	2253	2247
5786251 - 5788750	2268	2283	2280	2254	2248
5788751 - 5791250	2289	2284	2281	2255	2249
5791251 - 5793750	2270	2285	2282	2258	2250
5793751 - 5798250	2271	2288	2283	2257	2251
5796251 - 5798750	2272	2287	2284	2258	2252
5798751 - 5801250	2273	2288	2285	2259	2253

GK NORTHING 5800000

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
5798751 - 5801250	2273	2288	2285	2259	2253
5801251 - 5803750	2274	2289	2266	2280	2254
5803751 - 5806250	2275	2270	2287	2261	2255
5806251 - 5808750	2278	2271	2268	2282	2258
5808751 - 5811250	2277	2272	2289	2283	2257
5811251 - 5813750	2278	2273	2270	2284	2258
5813751 - 5816250	2279	2274	2271	2265	2259
5816251 - 5818750	2280	2275	2272	2286	2280
5818751 - 5821250	2281	2278	2273	2287	2281
5821251 - 5823750	2282	2277	2274	2288	2282
5823751 - 5826250	2283	2278	2275	2289	2283
5826251 - 5828750	2284	2279	2278	2270	2284
5828751 - 5831250	2285	2280	2277	2271	2285
5831251 - 5833750	2286	2281	2278	2272	2288
5833751 - 5836250	2287	2282	2279	2273	2287
5836251 - 5838750	2288	2283	2280	2274	2288
5838751 - 5841250	2289	2284	2281	2275	2289
5841251 - 5843750	2290	2285	2282	2278	2270
5843751 - 5846250	2291	2288	2283	2277	2271
5846251 - 5848750	2292	2287	2284	2278	2272
5848751 - 5851250	2293	2288	2285	2279	2273
5851251 - 5853750	2294	2289	2288	2280	2274
5853751 - 5856250	2295	2290	2287	2281	2275
5856251 - 5858750	2298	2291	2288	2282	2278
5858751 - 5861250	2297	2292	2289	2283	2277
5861251 - 5863750	2298	2293	2290	2284	2278
5863751 - 5866250	2299	2294	2291	2285	2279
5866251 - 5868750	2300	2295	2292	2288	2280
5868751 - 5871250	2301	2298	2293	2287	2281
5871251 - 5873750	2302	2297	2294	2288	2282
5873751 - 5876250	2303	2298	2295	2289	2283
5876251 - 5878750	2304	2299	2298	2290	2284
5878751 - 5881250	2305	2300	2297	2291	2285
5881251 - 5883750	2306	2301	2298	2292	2286
5883751 - 5886250	2307	2302	2299	2293	2287
5886251 - 5888750	2308	2303	2300	2294	2288
5888751 - 5891250	2309	2304	2301	2295	2289
5891251 - 5893750	2310	2305	2302	2298	2290
5893751 - 5896250	2311	2306	2303	2297	2291
5896251 - 5898750	2312	2307	2304	2298	2292
5898751 - 5901250	2313	2308	2305	2299	2293

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
5898751 - 5901250	2313	2308	2305	2299	2293
5901251 - 5903750	2314	2309	2308	2300	2294
5903751 - 5906250	2315	2310	2307	2301	2295
5906251 - 5908750	2316	2311	2308	2302	2298
5908751 - 5911250	2317	2312	2309	2303	2297
5911251 - 5913750	2318	2313	2310	2304	2298
5913751 - 5916250	2319	2314	2311	2305	2299
5916251 - 5918750	2320	2315	2312	2308	2300
5918751 - 5921250	2321	2316	2313	2307	2301
5921251 - 5923750	2322	2317	2314	2308	2302
5923751 - 5926250	2323	2318	2315	2309	2303
5926251 - 5928750	2324	2319	2318	2310	2304
5928751 - 5931250	2325	2320	2317	2311	2305
5931251 - 5933750	2326	2321	2318	2312	2306
5933751 - 5936250	2327	2322	2319	2313	2307
5936251 - 5938750	2328	2323	2320	2314	2308
5938751 - 5941250	2329	2324	2321	2315	2309
5941251 - 5943750	2330	2325	2322	2318	2310
5943751 - 5946250	2331	2328	2323	2317	2311
5946251 - 5948750	2332	2327	2324	2318	2312
5948751 - 5951250	2333	2328	2325	2319	2313
5951251 - 5953750	2334	2329	2328	2320	2314
5953751 - 5956250	2335	2330	2327	2321	2315
5956251 - 5958750	2336	2331	2328	2322	2318
5958751 - 5961250	2337	2332	2329	2323	2317
5961251 - 5963750	2338	2333	2330	2324	2318
5963751 - 5966250	2339	2334	2331	2325	2319
5966251 - 5968750	2340	2335	2332	2326	2320
5968751 - 5971250	2341	2338	2333	2327	2321
5971251 - 5973750	2342	2337	2334	2328	2322
5973751 - 5976250	2343	2338	2335	2329	2323
5976251 - 5978750	2344	2339	2338	2330	2324
5978751 - 5981250	2345	2340	2337	2331	2325
5981251 - 5983750	2346	2341	2338	2332	2328
5983751 - 5986250	2347	2342	2339	2333	2327
5986251 - 5988750	2348	2343	2340	2334	2328
5988751 - 5991250	2349	2344	2341	2335	2329
5991251 - 5993750	2350	2345	2342	2336	2330
5993751 - 5996250	2351	2346	2343	2337	2331
5996251 - 5998750	2352	2347	2344	2338	2332
5998751 - 6001250	2353	2348	2345	2339	2333

GK NORTHING 6000000

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
5998751 - 8001250	2353	2346	2345	2339	2333
6001251 - 8003750	2354	2349	2346	2340	2334
6003751 - 8008250	2355	2350	2347	2341	2335
6008251 - 8008750	2358	2351	2348	2342	2336
6008751 - 8011250	2357	2352	2349	2343	2337
8011251 - 6013750	2358	2353	2350	2344	2338
6013751 - 8018250	2359	2354	2351	2345	2339
6016251 - 8018750	2380	2355	2352	2346	2340
6018751 - 6021250	2381	2358	2353	2347	2341
6021251 - 8023750	2382	2357	2354	2348	2342
8023751 - 6026250	2383	2358	2355	2349	2343
6026251 - 8028750	2384	2359	2358	2350	2344
6028751 - 8031250	2385	2380	2357	2351	2345
6031251 - 8033750	2388	2361	2358	2352	2348
6033751 - 8038250	2387	2382	2359	2353	2347
8036251 - 6038750	2388	2363	2380	2354	2348
6038751 - 6041250	2389	2384	2361	2355	2349
6041251 - 6043750	2370	2365	2382	2356	2350
6043751 - 8048250	2371	2388	2363	2357	2351
6048251 - 8048750	2372	2387	2384	2358	2352
6048751 - 8051250	2373	2388	2385	2359	2353
6051251 - 6053750	2374	2389	2388	2360	2354
6053751 - 6058250	2375	2370	2387	2381	2355
6056251 - 8058750	2378	2371	2388	2382	2358
6058751 - 6061250	2377	2372	2389	2383	2357
6081251 - 6063750	2378	2373	2370	2384	2358
6083751 - 8088250	2379	2374	2371	2385	2359
6066251 - 6088750	2380	2375	2372	2388	2380
6088751 - 6071250	2381	2378	2373	2387	2361
6071251 - 6073750	2382	2377	2374	2368	2382
6073751 - 8078250	2383	2378	2375	2389	2383
6076251 - 6078750	2384	2379	2378	2370	2364
6078751 - 8081250	2385	2360	2377	2371	2385
6081251 - 8083750	2386	2381	2378	2372	2366
8083751 - 8088250	2387	2382	2379	2373	2387
6086251 - 8088750	2388	2383	2380	2374	2388
6088751 - 8091250	2389	2384	2381	2375	2369
6091251 - 8093750	2390	2385	2382	2376	2370
6093751 - 6098250	2391	2388	2383	2377	2371
8096251 - 8098750	2392	2387	2384	2378	2372
6098751 - 8101250	2393	2388	2385	2379	2373

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
6098751 - 6101250	2393	2388	2385	2379	2373
6101251 - 6103750	2394	2389	2386	2380	2374
6103751 - 6106250	2395	2390	2387	2381	2375
6106251 - 6108750	2398	2391	2388	2382	2376
6108751 - 6111250	2397	2392	2389	2383	2377
6111251 - 6113750	2398	2393	2390	2384	2378
6113751 - 6116250	2399	2394	2391	2385	2379
6116251 - 6118750	2400	2395	2392	2388	2380
6118751 - 6121250	2401	2396	2393	2387	2381
6121251 - 6123750	2402	2397	2394	2388	2382
6123751 - 6126250	2403	2398	2395	2389	2383
6126251 - 6128750	2404	2399	2398	2390	2384
6128751 - 6131250	2405	2400	2397	2391	2385
6131251 - 8133750	2408	2401	2398	2392	2386
6133751 - 8138250	2407	2402	2399	2393	2387
6136251 - 6138750	2408	2403	2400	2394	2388
6138751 - 6141250	2409	2404	2401	2395	2389
6141251 - 6143750	2410	2405	2402	2398	2390
6143751 - 6146250	2411	2406	2403	2397	2391
6146251 - 6148750	2412	2407	2404	2398	2392
6148751 - 6151250	2413	2408	2405	2399	2393
6151251 - 6153750	2414	2409	2406	2400	2394
6153751 - 6156250	2415	2410	2407	2401	2395
6156251 - 6158750	2416	2411	2408	2402	2398
6158751 - 6161250	2417	2412	2409	2403	2397
6161251 - 6163750	2418	2413	2410	2404	2398
6163751 - 6166250	2419	2414	2411	2405	2399
6166251 - 6168750	2420	2415	2412	2406	2400
6168751 - 6171250	2421	2418	2413	2407	2401
6171251 - 6173750	2422	2417	2414	2408	2402
6173751 - 6176250	2423	2418	2415	2409	2403
6176251 - 6178750	2424	2419	2416	2410	2404
6178751 - 6181250	2425	2420	2417	2411	2405
6181251 - 6183750	2426	2421	2418	2412	2408
6183751 - 6186250	2427	2422	2419	2413	2407
6186251 - 6188750	2428	2423	2420	2414	2408
6188751 - 6191250	2429	2424	2421	2415	2409
6191251 - 6193750	2430	2425	2422	2416	2410
6193751 - 6196250	2431	2428	2423	2417	2411
6196251 - 6198750	2432	2427	2424	2418	2412
6198751 - 6201250	2433	2428	2425	2419	2413

GK NORTHING 6200000

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
6196751 - 6201250	2433	2426	2425	2419	2413
6201251 - 6203750	2434	2429	2426	2420	2414
6203751 - 6206250	2435	2430	2427	2421	2415
6206251 - 6208750	2436	2431	2426	2422	2416
6208751 - 6211250	2437	2432	2429	2423	2417
6211251 - 6213750	2438	2433	2430	2424	2416
6213751 - 6216250	2439	2434	2431	2425	2419
6216251 - 6216750	2440	2435	2432	2426	2420
6218751 - 6221250	2441	2436	2433	2427	2421
6221251 - 6223750	2442	2437	2434	2426	2422
6223751 - 6226250	2443	2436	2435	2429	2423
6226251 - 6226750	2444	2439	2436	2430	2424
6228751 - 6231250	2445	2440	2437	2431	2425
6231251 - 6233750	2446	2441	2436	2432	2426
6233751 - 6236250	2447	2442	2439	2433	2427
6236251 - 6238750	2448	2443	2440	2434	2426
6236751 - 6241250	2449	2444	2441	2435	2429
6241251 - 6243750	2450	2445	2442	2436	2430
6243751 - 6246250	2451	2446	2443	2437	2431
6246251 - 6248750	2452	2447	2444	2436	2432
6248751 - 6251250	2453	2448	2445	2439	2433
6251251 - 6253750	2454	2449	2446	2440	2434
6253751 - 6256250	2455	2450	2447	2441	2435
6256251 - 6258750	2456	2451	2448	2442	2436
6258751 - 6261250	2457	2452	2449	2443	2437
6261251 - 6263750	2458	2453	2450	2444	2438
6263751 - 6266250	2459	2454	2451	2445	2439
6266251 - 6268750	2460	2455	2452	2446	2440
6268751 - 6271250	2461	2456	2453	2447	2441
6271251 - 6273750	2462	2457	2454	2448	2442
6273751 - 6276250	2463	2456	2455	2449	2443
6276251 - 6278750	2464	2459	2456	2450	2444
6278751 - 6281250	2465	2460	2457	2451	2445
6281251 - 6283750	2466	2461	2458	2452	2446
6283751 - 6286250	2467	2462	2459	2453	2447
6286251 - 6288750	2468	2463	2460	2454	2446
6288751 - 6291250	2469	2464	2461	2455	2449
6291251 - 6293750	2470	2465	2462	2456	2450
6293751 - 6296250	2471	2466	2463	2457	2451
6296251 - 6298750	2472	2467	2464	2458	2452
6298751 - 6301250	2473	2468	2465	2459	2453

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
6298751 - 6301250	2473	2488	2465	2459	2453
6301251 - 6303750	2474	2469	2486	2460	2454
6303751 - 6306250	2475	2470	2467	2461	2455
6306251 - 6308750	2476	2471	2468	2482	2458
6308751 - 6311250	2477	2472	2489	2463	2457
6311251 - 6313750	2478	2473	2470	2464	2458
6313751 - 6316250	2479	2474	2471	2485	2459
6316251 - 6318750	2480	2475	2472	2486	2480
6318751 - 6321250	2481	2478	2473	2467	2461
6321251 - 6323750	2482	2477	2474	2468	2482
6323751 - 6326250	2483	2478	2475	2469	2463
6326251 - 6328750	2484	2479	2476	2470	2484
6328751 - 6331250	2485	2480	2477	2471	2465
6331251 - 6333750	2488	2481	2478	2472	2468
6333751 - 6336250	2487	2482	2479	2473	2487
6336251 - 6338750	2488	2483	2480	2474	2488
6338751 - 6341250	2489	2484	2481	2475	2469
6341251 - 6343750	2490	2485	2482	2478	2470
6343751 - 6346250	2491	2486	2483	2477	2471
6346251 - 6348750	2492	2487	2484	2478	2472
6348751 - 6351250	2493	2488	2485	2479	2473
6351251 - 6353750	2494	2489	2486	2480	2474
6353751 - 6356250	2495	2490	2487	2481	2475
6356251 - 6358750	2496	2491	2488	2482	2476
6358751 - 6361250	2497	2492	2489	2483	2477
6361251 - 6363750	2498	2493	2490	2484	2478
6363751 - 6366250	2499	2494	2491	2485	2479
6366251 - 6368750	2500	2495	2492	2488	2480
6368751 - 6371250	2501	2496	2493	2487	2481
6371251 - 6373750	2502	2497	2494	2488	2482
6373751 - 6376250	2503	2498	2495	2489	2483
6376251 - 6378750	2504	2499	2498	2490	2484
6378751 - 6381250	2505	2500	2497	2491	2485
6381251 - 6383750	2506	2501	2498	2492	2488
6383751 - 6386250	2507	2502	2499	2493	2487
6386251 - 6388750	2508	2503	2500	2494	2488
6388751 - 6391250	2509	2504	2501	2495	2489
6391251 - 6393750	2510	2505	2502	2498	2490
6393751 - 6396250	2511	2508	2503	2497	2491
6396251 - 6398750	2512	2507	2504	2498	2492
6398751 - 6401250	2513	2508	2505	2499	2493

GK NORTHING 6400000

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
6398751 - 6401250	2513	2508	2505	2499	2493
6401251 - 6403750	2514	2509	2508	2500	2494
6403751 - 6406250	2515	2510	2507	2501	2495
6406251 - 6408750	2516	2511	2508	2502	2498
6408751 - 6411250	2517	2512	2509	2503	2497
6411251 - 6413750	2518	2513	2510	2504	2498
6413751 - 8416250	2519	2514	2511	2505	2499
6416251 - 6418750	2520	2515	2512	2508	2500
6418751 - 6421250	2521	2518	2513	2507	2501
6421251 - 6423750	2522	2517	2514	2508	2502
6423751 - 6426250	2523	2518	2515	2509	2503
6426251 - 6428750	2524	2519	2518	2510	2504
6428751 - 6431250	2525	2520	2517	2511	2505
6431251 - 8433750	2528	2521	2518	2512	2508
6433751 - 6436250	2527	2522	2519	2513	2507
6436251 - 6438750	2528	2523	2520	2514	2508
6438751 - 6441250	2529	2524	2521	2515	2509
6441251 - 8443750	2530	2525	2522	2516	2510
6443751 - 6446250	2531	2528	2523	2517	2511
6446251 - 6448750	2532	2527	2524	2518	2512
6448751 - 6451250	2533	2528	2525	2519	2513
6451251 - 6453750	2534	2529	2526	2520	2514
6453751 - 6456250	2535	2530	2527	2521	2515
6456251 - 6458750	2538	2531	2528	2522	2516
6458751 - 6461250	2537	2532	2529	2523	2517
6461251 - 6463750	2538	2533	2530	2524	2518
6463751 - 6466250	2539	2534	2531	2525	2519
6466251 - 6468750	2540	2535	2532	2526	2520
6468751 - 6471250	2541	2536	2533	2527	2521
6471251 - 6473750	2542	2537	2534	2528	2522
6473751 - 6476250	2543	2538	2535	2529	2523
6476251 - 6478750	2544	2539	2536	2530	2524
6478751 - 6481250	2545	2540	2537	2531	2525
6481251 - 6483750	2546	2541	2538	2532	2528
6483751 - 6486250	2547	2542	2539	2533	2527
6486251 - 6488750	2548	2543	2540	2534	2528
6488751 - 6491250	2549	2544	2541	2535	2529
6491251 - 6493750	2550	2545	2542	2536	2530
6493751 - 6496250	2551	2548	2543	2537	2531
6496251 - 6498750	2552	2547	2544	2538	2532
6498751 - 6501250	2553	2548	2545	2539	2533

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
8498751 - 8501250	2553	2548	2545	2539	2533
8501251 - 8503750	2554	2549	2548	2540	2534
8503751 - 8506250	2555	2550	2547	2541	2535
8508251 - 8508750	2558	2551	2546	2542	2538
6506751 - 8511250	2557	2552	2549	2543	2537
6511251 - 8513750	2558	2553	2550	2544	2536
8513751 - 8516250	2559	2554	2551	2545	2539
6518251 - 8518750	2580	2555	2552	2548	2540
6518751 - 6521250	2581	2558	2553	2547	2541
8521251 - 8523750	2582	2557	2554	2546	2542
8523751 - 6526250	2583	2558	2555	2549	2543
8526251 - 6528750	2584	2559	2556	2550	2544
6528751 - 8531250	2585	2580	2557	2551	2545
6531251 - 8533750	2588	2581	2558	2552	2546
6533751 - 6538250	2587	2562	2559	2553	2547
8538251 - 6538750	2588	2583	2580	2554	2548
6538751 - 6541250	2589	2584	2581	2555	2549
8541251 - 8543750	2570	2585	2562	2558	2550
6543751 - 8548250	2571	2588	2563	2557	2551
8548251 - 8546750	2572	2587	2564	2558	2552
6548751 - 6551250	2573	2568	2565	2559	2553
8551251 - 8553750	2574	2589	2586	2580	2554
6553751 - 6556250	2575	2570	2587	2561	2555
8558251 - 8558750	2578	2571	2588	2562	2558
8556751 - 8581250	2577	2572	2589	2583	2557
8581251 - 8583750	2578	2573	2570	2584	2558
8583751 - 8568250	2579	2574	2571	2585	2559
8586251 - 8588750	2580	2575	2572	2588	2580
6588751 - 8571250	2581	2578	2573	2587	2581
8571251 - 8573750	2582	2577	2574	2586	2562
8573751 - 6578250	2583	2578	2575	2589	2583
6578251 - 8578750	2584	2579	2578	2570	2584
6578751 - 6561250	2585	2580	2577	2571	2585
8561251 - 6583750	2588	2581	2578	2572	2588
6583751 - 8588250	2587	2582	2579	2573	2587
8568251 - 6568750	2588	2563	2580	2574	2588
6586751 - 8591250	2589	2584	2581	2575	2589
8591251 - 6593750	2590	2565	2582	2578	2570
6593751 - 8598250	2591	2588	2563	2577	2571
8598251 - 8598750	2592	2567	2584	2576	2572
8598751 - 8801250	2593	2568	2585	2579	2573

GK NORTHING 6600000

GK NORTHING (X)	DELTA X (Δ X)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
6598751 - 6601250	2593	2588	2565	2579	2573
6601251 - 6603750	2594	2569	2566	2560	2574
6603751 - 6606250	2595	2590	2567	2561	2575
6606251 - 6608750	2596	2591	2566	2582	2576
6606751 - 6611250	2597	2592	2589	2583	2577
6611251 - 6613750	2598	2593	2590	2564	2576
6613751 - 6616250	2599	2594	2591	2565	2579
6616251 - 6618750	2600	2595	2592	2566	2560
6616751 - 6621250	2601	2596	2593	2567	2581
6621251 - 6623750	2602	2597	2594	2568	2562
6623751 - 6626250	2603	2596	2595	2569	2583
6626251 - 6626750	2604	2599	2596	2590	2564
6626751 - 6631250	2805	2600	2597	2591	2565
6631251 - 6633750	2608	2601	2598	2592	2586
6633751 - 6636250	2607	2602	2599	2593	2567
6636251 - 6638750	2608	2603	2600	2594	2566
6638751 - 6641250	2609	2804	2601	2595	2589
6641251 - 6643750	2610	2605	2602	2596	2590
6643751 - 6646250	2611	2806	2603	2597	2591
6646251 - 6646750	2812	2607	2604	2596	2592
6648751 - 6651250	2613	2608	2805	2599	2593
6651251 - 6653750	2614	2609	2606	2600	2594
6653751 - 6656250	2615	2810	2607	2601	2595
6656251 - 6658750	2616	2611	2608	2802	2598
6658751 - 6661250	2817	2612	2609	2603	2597
6661251 - 6663750	2618	2613	2610	2604	2598
6663751 - 6666250	2619	2614	2811	2805	2599
6666251 - 6668750	2820	2815	2612	2606	2600
6668751 - 6671250	2621	2616	2813	2807	2801
6671251 - 6673750	2622	2617	2614	2606	2802
6673751 - 6676250	2623	2818	2615	2609	2803
6676251 - 6676750	2624	2819	2618	2810	2804
6678751 - 6681250	2625	2820	2617	2611	2605
6681251 - 6683750	2626	2821	2618	2612	2606
6683751 - 6686250	2627	2622	2619	2613	2807
6686251 - 6668750	2628	2623	2820	2814	2806
6688751 - 6691250	2629	2824	2621	2615	2809
6691251 - 6693750	2630	2625	2622	2816	2610
6693751 - 6696250	2631	2626	2823	2817	2811
6696251 - 6698750	2632	2827	2824	2818	2612
6698751 - 6701250	2633	2828	2825	2619	2813

GK EASTING 200000

GK EASTING (Y)	DELTA Y (Δ Y)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
198751 - 201250	77	87	57	49	40
201251 - 203750	76	86	56	48	39
203751 - 206250	75	65	55	47	36
206251 - 208750	74	64	54	46	37
208751 - 211250	73	63	53	45	36
211251 - 213750	72	82	52	44	35
213751 - 216250	71	61	51	43	34
216251 - 218750	70	60	50	42	33
218751 - 221250	89	59	49	41	32
221251 - 223750	88	58	48	40	31
223751 - 226250	67	57	47	39	30
226251 - 228750	68	56	46	36	29
228751 - 231250	65	55	45	37	26
231251 - 233750	64	54	44	36	27
233751 - 236250	83	53	43	35	28
236251 - 238750	82	52	42	34	25
238751 - 241250	61	51	41	33	24
241251 - 243750	60	50	40	32	23
243751 - 246250	59	49	39	31	22
246251 - 248750	58	48	38	30	21
248751 - 251250	57	47	37	29	20
251251 - 253750	58	46	36	26	19
253751 - 256250	55	45	35	27	16
256251 - 258750	54	44	34	26	17
258751 - 261250	53	43	33	25	16
261251 - 263750	52	42	32	24	15
263751 - 266250	51	41	31	23	14
266251 - 268750	50	40	30	22	13
268751 - 271250	49	39	29	21	12
271251 - 273750	48	36	28	20	11
273751 - 278250	47	37	27	19	10
276251 - 278750	46	36	26	18	9
278751 - 281250	45	35	25	17	8
281251 - 283750	44	34	24	16	7
283751 - 286250	43	33	23	15	8
286251 - 288750	42	32	22	14	5
288751 - 291250	41	31	21	13	4
291251 - 293750	40	30	20	12	3
293751 - 298250	39	29	19	11	2
296251 - 298750	38	26	16	10	1
298751 - 301250	37	27	17	9	0

GK EASTING 300000

GK EASTING (Y)	DELTA Y (Δ Y)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
298751 - 301250	37	27	17	9	0
301251 - 303750	38	28	18	8	-1
303751 - 308250	35	25	15	7	-2
308251 - 308750	34	24	14	8	-3
308751 - 311250	33	23	13	5	-4
311251 - 313750	32	22	12	4	-5
313751 - 318250	31	21	11	3	-8
318251 - 318750	30	20	10	2	-7
318751 - 321250	29	19	9	1	-8
321251 - 323750	28	18	8	0	-9
323751 - 328250	27	17	7	-1	-10
328251 - 328750	28	18	8	-2	-11
328751 - 331250	25	15	5	-3	-12
331251 - 333750	24	14	4	-4	-13
333751 - 338250	23	13	3	-5	-14
338251 - 338750	22	12	2	-8	-15
338751 - 341250	21	11	1	-7	-18
341251 - 343750	20	10	0	-8	-17
343751 - 348250	19	9	-1	-9	-18
348251 - 348750	18	8	-2	-10	-19
348751 - 351250	17	7	-3	-11	-20
351251 - 353750	16	8	-4	-12	-21
353751 - 358250	15	5	-5	-13	-22
356251 - 358750	14	4	-8	-14	-23
358751 - 381250	13	3	-7	-15	-24
381251 - 383750	12	2	-8	-18	-25
383751 - 388250	11	1	-9	-17	-28
386251 - 388750	10	0	-10	-18	-27
368751 - 371250	9	-1	-11	-19	-28
371251 - 373750	8	-2	-12	-20	-29
373751 - 378250	7	-3	-13	-21	-30
378251 - 378750	8	-4	-14	-22	-31
378751 - 381250	5	-5	-15	-23	-32
381251 - 383750	4	-8	-18	-24	-33
383751 - 388250	3	-7	-17	-25	-34
388251 - 388750	2	-8	-18	-28	-35
388751 - 391250	1	-9	-19	-27	-38
391251 - 393750	0	-10	-20	-28	-37
393751 - 398250	-1	-11	-21	-29	-38
398251 - 398750	-2	-12	-22	-30	-39
398751 - 401250	-3	-13	-23	-31	-40

GK EASTING 400000

GK EASTING (Y)	DELTA Y (Δ Y)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
396751 - 401250	-3	-13	-23	-31	-40
401251 - 403750	-4	-14	-24	-32	-41
403751 - 406250	-5	-15	-25	-33	-42
406251 - 406750	-6	-16	-26	-34	-43
406751 - 411250	-7	-17	-27	-35	-44
411251 - 413750	-6	-16	-26	-36	-45
413751 - 416250	-9	-19	-29	-37	-46
416251 - 416750	-10	-20	-30	-36	-47
418751 - 421250	-11	-21	-31	-39	-48
421251 - 423750	-12	-22	-32	-40	-49
423751 - 426250	-13	-23	-33	-41	-50
426251 - 426750	-14	-24	-34	-42	-51
426751 - 431250	-15	-25	-35	-43	-52
431251 - 433750	-16	-26	-36	-44	-53
433751 - 436250	-17	-27	-37	-45	-54
436251 - 436750	-16	-26	-36	-46	-55
438751 - 441250	-19	-29	-39	-47	-56
441251 - 443750	-20	-30	-40	-46	-57
443751 - 446250	-21	-31	-41	-49	-56
446251 - 446750	-22	-32	-42	-50	-59
446751 - 451250	-23	-33	-43	-51	-60
451251 - 453750	-24	-34	-44	-52	-61
453751 - 456250	-25	-35	-45	-53	-62
456251 - 456750	-26	-36	-46	-54	-63
456751 - 461250	-27	-37	-47	-55	-64
461251 - 463750	-26	-36	-46	-56	-65
463751 - 466250	-29	-39	-49	-57	-66
466251 - 466750	-30	-40	-50	-56	-67
466751 - 471250	-31	-41	-51	-59	-66
471251 - 473750	-32	-42	-52	-60	-69
473751 - 476250	-33	-43	-53	-61	-70
476251 - 476750	-34	-44	-54	-62	-71
476751 - 461250	-35	-45	-55	-63	-72
461251 - 463750	-36	-46	-56	-64	-73
463751 - 466250	-37	-47	-57	-65	-74
466251 - 466750	-36	-46	-56	-66	-75
486751 - 491250	-39	-49	-59	-67	-76
491251 - 493750	-40	-50	-60	-66	-77
493751 - 496250	-41	-51	-61	-69	-76
496251 - 496750	-42	-52	-62	-70	-79
496751 - 501250	-43	-53	-63	-71	-60

GK EASTING 500000

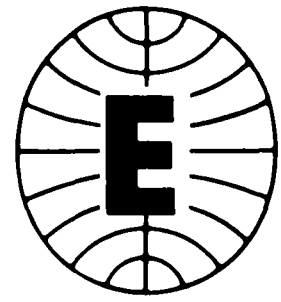
GK EASTING (Y)	DELTA Y (Δ Y)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
498751 - 501250	-43	-53	-63	-71	-80
501251 - 503750	-44	-54	-84	-72	-81
503751 - 506250	-45	-55	-85	-73	-82
506251 - 508750	-46	-56	-66	-74	-83
508751 - 511250	-47	-57	-67	-75	-84
511251 - 513750	-48	-58	-68	-76	-85
513751 - 516250	-49	-59	-69	-77	-86
516251 - 518750	-50	-60	-70	-78	-87
518751 - 521250	-51	-81	-71	-79	-88
521251 - 523750	-52	-82	-72	-80	-89
523751 - 526250	-53	-83	-73	-81	-90
526251 - 528750	-54	-64	-74	-82	-91
528751 - 531250	-55	-85	-75	-83	-92
531251 - 533750	-56	-68	-78	-84	-93
533751 - 536250	-57	-67	-77	-85	-94
536251 - 538750	-58	-88	-78	-86	-95
538751 - 541250	-59	-89	-79	-87	-96
541251 - 543750	-60	-70	-80	-88	-97
543751 - 546250	-61	-71	-81	-89	-98
546251 - 548750	-62	-72	-82	-90	-99
548751 - 551250	-63	-73	-83	-91	-100
551251 - 553750	-64	-74	-84	-92	-101
553751 - 556250	-65	-75	-85	-93	-102
556251 - 558750	-66	-76	-88	-94	-103
558751 - 561250	-67	-77	-87	-95	-104
561251 - 563750	-68	-78	-88	-98	-105
563751 - 566250	-69	-79	-89	-97	-106
566251 - 568750	-70	-80	-90	-98	-107
568751 - 571250	-71	-81	-91	-99	-108
571251 - 573750	-72	-82	-92	-100	-109
573751 - 576250	-73	-83	-93	-101	-110
576251 - 578750	-74	-84	-94	-102	-111
578751 - 581250	-75	-85	-95	-103	-112
581251 - 583750	-76	-86	-96	-104	-113
583751 - 586250	-77	-87	-97	-105	-114
586251 - 588750	-78	-88	-98	-106	-115
588751 - 591250	-79	-89	-99	-107	-118
591251 - 593750	-80	-90	-100	-108	-117
593751 - 596250	-81	-91	-101	-109	-118
596251 - 598750	-82	-92	-102	-110	-119
598751 - 601250	-83	-93	-103	-111	-120

GK EASTING (Y)	DELTA Y (Δ Y)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
596751 - 601250	-63	-93	-103	-111	-120
601251 - 603750	-84	-94	-104	-112	-121
603751 - 606250	-85	-95	-105	-113	-122
606251 - 606750	-66	-98	-108	-114	-123
608751 - 611250	-87	-97	-107	-115	-124
611251 - 613750	-68	-98	-108	-118	-125
613751 - 616250	-89	-99	-109	-117	-126
616251 - 616750	-90	-100	-110	-116	-127
618751 - 621250	-91	-101	-111	-119	-128
621251 - 623750	-92	-102	-112	-120	-129
623751 - 626250	-93	-103	-113	-121	-130
626251 - 628750	-94	-104	-114	-122	-131
626751 - 631250	-95	-105	-115	-123	-132
631251 - 633750	-96	-106	-118	-124	-133
633751 - 636250	-97	-107	-117	-125	-134
636251 - 638750	-98	-106	-118	-128	-135
638751 - 641250	-99	-109	-119	-127	-136
641251 - 643750	-100	-110	-120	-126	-137
643751 - 646250	-101	-111	-121	-129	-138
646251 - 646750	-102	-112	-122	-130	-139
648751 - 651250	-103	-113	-123	-131	-140
651251 - 653750	-104	-114	-124	-132	-141
653751 - 656250	-105	-115	-125	-133	-142
656251 - 656750	-106	-118	-128	-134	-143
658751 - 661250	-107	-117	-127	-135	-144
661251 - 663750	-106	-118	-128	-138	-145
663751 - 666250	-109	-119	-129	-137	-148
666251 - 668750	-110	-120	-130	-136	-147
666751 - 671250	-111	-121	-131	-139	-148
671251 - 673750	-112	-122	-132	-140	-149
673751 - 676250	-113	-123	-133	-141	-150
676251 - 676750	-114	-124	-134	-142	-151
676751 - 681250	-115	-125	-135	-143	-152
681251 - 683750	-116	-128	-138	-144	-153
683751 - 686250	-117	-127	-137	-145	-154
686251 - 686750	-116	-128	-138	-146	-155
688751 - 691250	-119	-129	-139	-147	-156
691251 - 693750	-120	-130	-140	-146	-157
693751 - 696250	-121	-131	-141	-149	-156
696251 - 696750	-122	-132	-142	-150	-159
696751 - 701250	-123	-133	-143	-151	-180

GK EASTING 700000

GK EASTING (Y)	DELTA Y (Δ Y)				
	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
698751 - 701250	-123	-133	-143	-151	-160
701251 - 703750	-124	-134	-144	-152	-161
703751 - 706250	-125	-135	-145	-153	-162
706251 - 706750	-126	-136	-146	-154	-163
708751 - 711250	-127	-137	-147	-155	-164
711251 - 713750	-126	-138	-146	-156	-165
713751 - 716250	-129	-139	-149	-157	-168
716251 - 718750	-130	-140	-150	-156	-167
718751 - 721250	-131	-141	-151	-159	-166
721251 - 723750	-132	-142	-152	-180	-189
723751 - 726250	-133	-143	-153	-161	-170
726251 - 728750	-134	-144	-154	-162	-171
728751 - 731250	-135	-145	-155	-163	-172
731251 - 733750	-136	-146	-156	-164	-173
733751 - 736250	-137	-147	-157	-165	-174
736251 - 738750	-136	-146	-158	-166	-175
738751 - 741250	-139	-149	-159	-167	-176
741251 - 743750	-140	-150	-160	-166	-177
743751 - 746250	-141	-151	-181	-189	-176
746251 - 748750	-142	-152	-162	-170	-179
748751 - 751250	-143	-153	-163	-171	-180
751251 - 753750	-144	-154	-164	-172	-161
753751 - 756250	-145	-155	-165	-173	-182
756251 - 758750	-146	-156	-168	-174	-163
758751 - 761250	-147	-157	-167	-175	-184
761251 - 763750	-148	-158	-168	-176	-185
763751 - 766250	-149	-159	-169	-177	-186
766251 - 768750	-150	-180	-170	-178	-187
768751 - 771250	-151	-181	-171	-179	-188
771251 - 773750	-152	-162	-172	-160	-169
773751 - 776250	-153	-183	-173	-161	-190
776251 - 778750	-154	-184	-174	-182	-191
778751 - 781250	-155	-165	-175	-183	-192
781251 - 783750	-156	-186	-178	-184	-193
783751 - 786250	-157	-187	-177	-185	-194
786251 - 788750	-158	-166	-176	-166	-195
788751 - 791250	-159	-189	-179	-187	-198
791251 - 793750	-160	-170	-180	-188	-197
793751 - 796250	-161	-171	-161	-169	-196
796251 - 798750	-162	-172	-182	-190	-199
798751 - 801250	-163	-173	-183	-191	-200

Appendix



GRID BLOCK CONVERSION TABLES

This appendix consists of grid block conversion tables for Gauss-Krasovskij (GK) zones 1 through 5. The tables provide the capability of converting GK to UTM 100,000-meter diagraphs for each of the five GK zones.

ZONE 1

59 12 = 31U BV	54 12 = 31U BQ	49 12 = 31T BK
59 13 = 31U CV	54 13 = 31U CQ	49 13 = 31T CK
59 14 = 31U DV	54 14 = 31U DQ	49 14 = 31T DK
59 15 = 31U EV	54 15 = 31U EQ	49 15 = 31T EK
59 16 = 31U FV	54 16 = 31U FQ	49 16 = 31T FK
59 17 = 31U GV	54 17 = 31U GQ	49 17 = 31T GK
58 12 = 31U BU	53 12 = 31U BP	48 12 = 31T BJ
58 13 = 31U CU	53 13 = 31U CP	48 13 = 31T CJ
58 14 = 31U DU	53 14 = 31U DP	48 14 = 31T DJ
58 15 = 31U EU	53 15 = 31U EP	48 15 = 31T EJ
58 16 = 31U FU	53 16 = 31U FP	48 16 = 31T FJ
58 17 = 31U GU	53 17 = 31U GP	48 17 = 31T GJ
57 12 = 31U BT	52 12 = 31T BN	47 12 = 31T BH
57 13 = 31U CT	52 13 = 31T CN	47 13 = 31T CH
57 14 = 31U DT	52 14 = 31T DN	47 14 = 31T DH
57 15 = 31U ET	52 15 = 31T EN	47 15 = 31T EH
57 16 = 31U FT	52 16 = 31T FN	47 16 = 31T FH
57 17 = 31U GT	52 17 = 31T GN	47 17 = 31T GH
56 12 = 31U BS	51 12 = 31T BM	46 12 = 31T BG
56 13 = 31U CS	51 13 = 31T CM	46 13 = 31T CG
56 14 = 31U DS	51 14 = 31T DM	46 14 = 31T DG
56 15 = 31U ES	51 15 = 31T EM	46 15 = 31T EG
56 16 = 31U FS	51 16 = 31T FM	46 16 = 31T FG
56 17 = 31U GS	51 17 = 31T GM	46 17 = 31T GG
55 12 = 31U BR	50 12 = 31T BL	
55 13 = 31U CR	50 13 = 31T CL	
55 14 = 31U DR	50 14 = 31T DL	
55 15 = 31U ER	50 15 = 31T EL	
55 16 = 31U FR	50 16 = 31T FL	
55 17 = 31U GR	50 17 = 31T GL	

ZONE 2

63 23 = 32V LJ
63 24 = 32V MJ
63 25 = 32V NJ
63 26 = 32V PJ

62 23 = 32V LH
62 24 = 32V MH
62 25 = 32V NH
62 26 = 32V PH

61 23 = 32U LG
61 24 = 32U MG
61 25 = 32U NG
61 26 = 32U PG

60 23 = 32U LF
60 24 = 32U MF
60 25 = 32U NF
60 26 = 32U PF

59 22 = 32U KE
59 23 = 32U LE
59 24 = 32U ME
59 25 = 32U NE
59 26 = 32U PE
59 27 = 32U QE

58 22 = 32U KD
58 23 = 32U LD
58 24 = 32U MD
58 25 = 32U ND
58 26 = 32U PD
58 27 = 32U QD

57 22 = 32U KC
57 23 = 32U LC
57 24 = 32U MC
57 25 = 32U NC
57 26 = 32U PC
57 27 = 32U QC

56 22 = 32U KB
56 23 = 32U LB
56 24 = 32U MB
56 25 = 32U NB
56 26 = 32U PB
56 27 = 32U QB

55 22 = 32U KA
55 23 = 32U LA
55 24 = 32U MA
55 25 = 32U NA
55 26 = 32U PA
55 27 = 32U QA

54 22 = 32U KV
54 23 = 32U LV
54 24 = 32U MV
54 25 = 32U NV
54 26 = 32U PV
54 27 = 32U QV

53 22 = 32U KU
53 23 = 32U LU
53 24 = 32U MU
53 25 = 32U NU
53 26 = 32U PU
53 27 = 32U QU

52 22 = 32T KT
52 23 = 32T LT
52 24 = 32T MT
52 25 = 32T NT
52 26 = 32T PT
52 27 = 32T QT

51 22 = 32T KS
51 23 = 32T LS
51 24 = 32T MS
51 25 = 32T NS
51 26 = 32T PS
51 27 = 32T QS

50 22 = 32T KR
50 23 = 32T LR
50 24 = 32T MR
50 25 = 32T NR
50 26 = 32T PR
50 27 = 32T QR

49 22 = 32T KQ
49 23 = 32T LQ
49 24 = 32T MQ
49 25 = 32T NQ
49 26 = 32T PQ
49 27 = 32T QQ

48 22 = 32T KP
48 23 = 32T LP
48 24 = 32T MP
48 25 = 32T NP
48 26 = 32T PP
48 27 = 32T QP

47 22 = 32T KN
47 23 = 32T LN
47 24 = 32T MN
47 25 = 32T NN
47 26 = 32T PN
47 27 = 32T QN

46 22 = 32T KM
46 23 = 32T LM
46 24 = 32T MM
46 25 = 32T NM
46 26 = 32T PM
46 27 = 32T QM

ZONE 3

63 33 = 33V UD
63 34 = 33V VD
63 35 = 33V WD
63 36 = 33V XD

62 33 = 33V UC
62 34 = 33V VC
62 35 = 33V WC
62 36 = 33V XC

61 33 = 33U UB
61 34 = 33U VB
61 35 = 33U WB
61 36 = 33U XB

60 33 = 33U UA
60 34 = 33U VA
60 35 = 33U WA
60 36 = 33U XA

59 32 = 33U TV
59 33 = 33U UV
59 34 = 33U VV
59 35 = 33U WV
59 36 = 33U XV
59 37 = 33U YV

58 32 = 33U TU
58 33 = 33U UU
58 34 = 33U VU
58 35 = 33U WU
58 36 = 33U XU
58 37 = 33U YU

57 32 = 33U TT
57 33 = 33U UT
57 34 = 33U VT
57 35 = 33U WT
57 36 = 33U XT
57 37 = 33U YT

56 32 = 33U TS
56 33 = 33U US
56 34 = 33U VS
56 35 = 33U WS
56 36 = 33U XS
56 37 = 33U YS

55 32 = 33U TR
55 33 = 33U UR
55 34 = 33U VR
55 35 = 33U WR
55 36 = 33U XR
55 37 = 33U YR

54 32 = 33U TQ
54 33 = 33U UQ
54 34 = 33U VQ
54 35 = 33U WQ
54 36 = 33U XQ
54 37 = 33U YQ

53 32 = 33U TP
53 33 = 33U UP
53 34 = 33U VP
53 35 = 33U WP
53 36 = 33U XP
53 37 = 33U YP

52 32 = 33T TN
52 33 = 33T UN
52 34 = 33T VN
52 35 = 33T WN
52 36 = 33T XN
52 37 = 33T YN

51 32 = 33T TM
51 33 = 33T UM
51 34 = 33T VM
51 35 = 33T WM
51 36 = 33T XM
51 37 = 33T YM

50 32 = 33T TL
50 33 = 33T UL
50 34 = 33T VL
50 35 = 33T WL
50 36 = 33T XL
50 37 = 33T YL

49 32 = 33T TK
49 33 = 33T UK
49 34 = 33T VK
49 35 = 33T WK
49 36 = 33T XK
49 37 = 33T YK

48 32 = 33T TJ
48 33 = 33T UJ
48 34 = 33T VJ
48 35 = 33T WJ
48 36 = 33T XJ
48 37 = 33T YJ

47 32 = 33T TH
47 33 = 33T UH
47 34 = 33T VH
47 35 = 33T WH
47 36 = 33T XH
47 37 = 33T YH

46 32 = 33T TG
46 33 = 33T UG
46 34 = 33T VG
46 35 = 33T WG
46 36 = 33T XG
46 37 = 33T YG

ZONE 4

66 43 = 34V CM
66 44 = 34V DM
66 45 = 34V EM
66 46 = 34V FM

65 43 = 34V CL
65 44 = 34V DL
65 45 = 34V EL
65 46 = 34V FL

64 43 = 34V CK
64 44 = 34V DK
64 45 = 34V EK
64 46 = 34V FK

63 43 = 34V CJ
63 44 = 34V DJ
63 45 = 34V EJ
63 46 = 34V FJ

62 43 = 34V CH
62 44 = 34V DH
62 45 = 34V EH
62 46 = 34V FH

61 43 = 34U CG
61 44 = 34U DG
61 45 = 34U EG
61 46 = 34U FG

60 43 = 34U CF
60 44 = 34U DF
60 45 = 34U EF
60 46 = 34U FF

59 42 = 34U BE
59 43 = 34U CE
59 44 = 34U DE
59 45 = 34U EE
59 46 = 34U FE
59 47 = 34U GE

58 42 = 34U BD
58 43 = 34U CD
58 44 = 34U DD
58 45 = 34U ED
58 46 = 34U FD
58 47 = 34U GD

57 42 = 34U BC
57 43 = 34U CC
57 44 = 34U DC
57 45 = 34U EC
57 46 = 34U FC
57 47 = 34U GC

56 42 = 34U BB
56 43 = 34U CB
56 44 = 34U DB
56 45 = 34U EB
56 46 = 34U FB
56 47 = 34U GB

55 42 = 34U BA
55 43 = 34U CA
55 44 = 34U DA
55 45 = 34U EA
55 46 = 34U FA
55 47 = 34U GA

54 42 = 34U BV
54 43 = 34U CV
54 44 = 34U DV
54 45 = 34U EV
54 46 = 34U FV
54 47 = 34U GV

53 42 = 34U BU
53 43 = 34U CU
53 44 = 34U DU
53 45 = 34U EU
53 46 = 34U FU
53 47 = 34U GU

52 42 = 34T BT
52 43 = 34T CT
52 44 = 34T DT
52 45 = 34T ET
52 46 = 34T FT
52 47 = 34T GT

51 42 = 34T BS
51 43 = 34T CS
51 44 = 34T DS
51 45 = 34T ES
51 46 = 34T FS
51 47 = 34T GS

50 42 = 34T BR
50 43 = 34T CR
50 44 = 34T DR
50 45 = 34T ER
50 46 = 34T FR
50 47 = 34T GR

49 42 = 34T BQ
49 43 = 34T CQ
49 44 = 34T DQ
49 45 = 34T EQ
49 46 = 34T FQ
49 47 = 34T GQ

48 42 = 34T BP
48 43 = 34T CP
48 44 = 34T DP
48 45 = 34T EP
48 46 = 34T FP
48 47 = 34T GP

47 42 = 34T BN
47 43 = 34T CN
47 44 = 34T DN
47 45 = 34T EN
47 46 = 34T FN
47 47 = 34T GN

ZONE 5

66 53 = 35V LG
66 54 = 35V MG
66 55 = 35V NG
66 56 = 35V PG

65 53 = 35V LF
65 54 = 35V MF
65 55 = 35V NF
65 56 = 35V PF

64 53 = 35V LE
64 54 = 35V ME
64 55 = 35V NE
64 56 = 35V PE

63 53 = 35V LD
63 54 = 35V MD
63 55 = 35V ND
63 56 = 35V PD

62 53 = 35V LC
62 54 = 35V MC
62 55 = 35V NC
62 56 = 35V PC

61 53 = 35U LB
61 54 = 35U MB
61 55 = 35U NB
61 56 = 35U PB

60 53 = 35U LA
60 54 = 35U MA
60 55 = 35U NA
60 56 = 35U PA

59 52 = 35U KV
59 53 = 35U LV
59 54 = 35U MV
59 55 = 35U NV
59 56 = 35U PV
59 57 = 35U QV

58 52 = 35U KU
58 53 = 35U LU
58 54 = 35U MU
58 55 = 35U NU
58 56 = 35U PU
58 57 = 35U QU

57 52 = 35U KT
57 53 = 35U LT
57 54 = 35U MT
57 55 = 35U NT
57 56 = 35U PT
57 57 = 35U QT

56 52 = 35U KS
56 53 = 35U LS
56 54 = 35U MS
56 55 = 35U NS
56 56 = 35U PS
56 57 = 35U QS

55 52 = 35U KR
55 53 = 35U LR
55 54 = 35U MR
55 55 = 35U NR
55 56 = 35U PR
55 57 = 35U QR

54 52 = 35U KQ
54 53 = 35U LQ
54 54 = 35U MQ
54 55 = 35U NQ
54 56 = 35U PQ
54 57 = 35U QQ

53 52 = 35U KP
53 53 = 35U LP
53 54 = 35U MP
53 55 = 35U NP
53 56 = 35U PP
53 57 = 35U QP

52 52 = 35T KN
52 53 = 35T LN
52 54 = 35T MN
52 55 = 35T NN
52 56 = 35T PN
52 57 = 35T QN

51 52 = 35T KM
51 53 = 35T LM
51 54 = 35T MM
51 55 = 35T NM
51 56 = 35T PM
51 57 = 35T QM

50 52 = 35T KL
50 53 = 35T LL
50 54 = 35T ML
50 55 = 35T NL
50 56 = 35T PL
50 57 = 35T QL

49 52 = 35T KK
49 53 = 35T LK
49 54 = 35T MK
49 55 = 35T NK
49 56 = 35T PK
49 57 = 35T QK

48 52 = 35T KJ
48 53 = 35T LJ
48 54 = 35T MJ
48 55 = 35T NJ
48 56 = 35T PJ
48 57 = 35T QJ

47 52 = 35T KH
47 53 = 35T LH
47 54 = 35T MH
47 55 = 35T NH
47 56 = 35T PH
47 57 = 35T QH

ZONE 4

NORWAY

46 42 = 34T BM
46 43 = 34T CM
46 44 = 34T DM
46 45 = 34T EM
46 46 = 34T FM
46 47 = 34T GM

45 42 = 34T BL
45 43 = 34T CL
45 44 = 34T DL
45 45 = 34T EL
45 46 = 34T FL
45 47 = 34T GL

44 42 = 34T BK
44 43 = 34T CK
44 44 = 34T DK
44 45 = 34T EK
44 46 = 34T FK
44 47 = 34T GK

76 43 = 34W CB
76 44 = 34W DB
76 45 = 34W EB
76 46 = 34W FB

77 43 = 34W CC
77 44 = 34W DC
77 45 = 34W EC
77 46 = 34W FC

78 43 = 34W CD
78 44 = 34W DD
78 45 = 34W ED
78 46 = 34W FD

ZONE 5

NORWAY

46 52 = 35T KG
46 53 = 35T LG
46 54 = 35T MG
46 55 = 35T NG
46 56 = 35T PG
46 57 = 35T QG

45 52 = 35T KF
45 53 = 35T LF
45 54 = 35T MF
45 55 = 35T NF
45 56 = 35T PF
45 57 = 35T QF

44 52 = 35T KE
44 53 = 35T LE
44 54 = 35T ME
44 55 = 35T NE
44 56 = 35T PE
44 57 = 35T QE

76 53 = 35W LS
76 54 = 35W MS
76 55 = 35W NS
76 56 = 35W PS

77 53 = 35W LT
77 54 = 35W MT
77 55 = 35W NT
77 56 = 35W PT

78 53 = 35W LU
78 54 = 35W MU
78 55 = 35W NU
78 56 = 35W PU

Appendix F

CONVERSION FORMULAS

Russian Gauss-Krasovskij coordinates Pulkova 1942 datum are converted to European datum UTM military coordinates by the following formulas:

WHERE:

$N = .9996X + C$

$E = .9996Y + D$

N = UTM grid northing

E = UTM grid easting

X = Russian Gauss-Krasovskij grid northing

Y = Russian Gauss-Krasovskij grid easting with zone number removed.

The values of C and D are given in table 1 with the areas of application defined by zone number and latitude (ϕ) band.

Zone	1(31)	2(32)	3(33)	4(34)	4(34)	5(35)	5(35)
C.M.	3E	9E	15E	21E	21E	27E	27E
ϕ(N)	42-54N	42-57N	42-57N	40-60N	69-71N	40-60N	69-71N
C	47.15	51.71	55.36	60.67	64.10	66.56	69.71
D	156.72	146.86	137.38	128.63	133.96	120.10	125.87

Table 1. C and D values.

Note!

The Russian Gauss-Krasovskij zones are numbered 1 through 5, and the corresponding UTM zone numbers are 31 through 35.

Please note that the values of C and D may be rounded off to the nearest whole number and still be extremely accurate. However, those desiring the greatest possible accuracy in converting GK to UTM military coordinates should use the values for C and D as they appear in table 1.

THE TRUE ACCURACY OF C AND D CAN ONLY BE DETERMINED BY APPLICATION TO REAL DATA.

Furthermore, the accuracy is dependent upon the following three factors:

1. **The conversion formula itself.**
2. **The map used.**
3. **The accuracy to which the Warsaw Pact and NATO soldiers are working; i.e., the accuracy of the measurement itself.**

Referring to table 1, the relationship between Pulkova 1942 datum and European datum is expressed by two high degree polynomials which convert Pulkova 1942 geographics to European datum geographics. The values of C and D were determined by computing European datum coordinates at selected points in each area using the polynomials and then computing datum difference in terms of grid coordinates. The precision of C and D are given in table 2. The values in table 2 are 90 percent linear errors in meters.

Zone	1(31)	2(32)	3(33)	4(34)	4(34)	5(35)	5(35)
∅(N)	42-54N	44-57N	42-57N	40-60N	69-71N	40-60N	69-71N
E_C	0.41	0.45	0.48	0.68	0.32	0.70	0.34
E_D	0.19	0.19	0.20	0.32	0.31	0.33	0.33

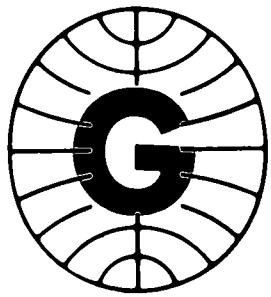
Table 2. C and D accuracy

Again we want to reiterate - THE TRUE ACCURACY OF C AND D CAN ONLY BE DETERMINED BY APPLICATION TO REAL DATA.

Note!

The information contained in this appendix was furnished by the Defense Mapping Agency, Hydrographic/Topographic Center, Geodesy and Surveys Department, Satellite Geophysics Division, Washington, D. C.

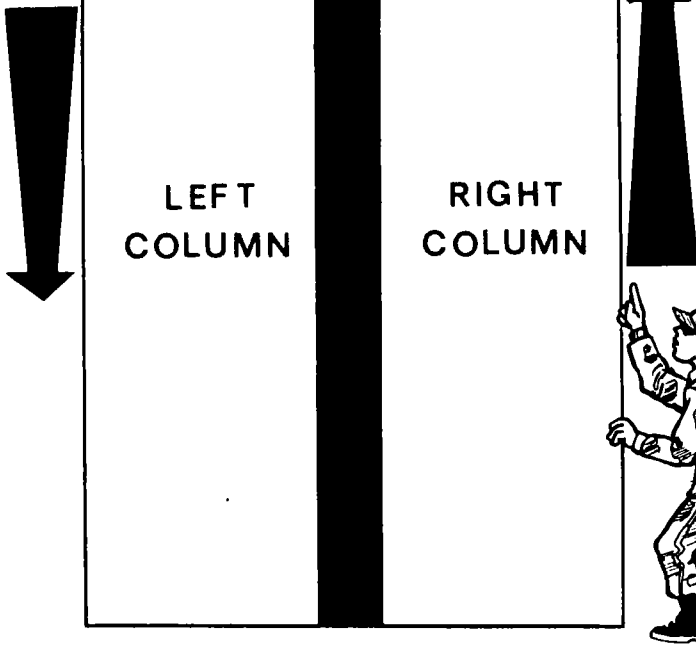
Appendix

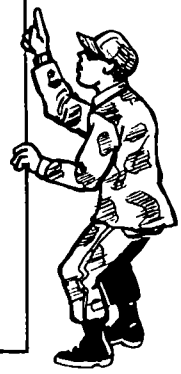


TABLES OF NATURAL TRIGONOMETRIC FUNCTIONS — SINE; COSINE FOR ANGLES IN DEGREES AND DECIMALS

The Tables of Natural Trigonometric Functions for SINE and COSINE give the values of the SINE and COSINE for each tenth of a degree from 0 to 359.

For angle values in the left column, use the column headings at the top of each column and read DOWN.





For angle values in the right column, use column headings at the top of each column and read UP from the bottom of the page.

READ DOWN

SIN − COS −	SIN + COS +	SIN	COS	SIN + COS −	SIN − COS +
180.0	0.0	0.00000	1.0000	180.0	360.0
.1	.1	.00175	1.0000	.9	.9
.2	.2	.00349	1.0000	.8	.8
.3	.3	.00524	1.0000	.7	.7
.4	.4	.00698	1.0000	.6	.6
.5	.5	.00873	1.0000	.5	.5
.6	.6	.01047	0.9999	.4	.4
.7	.7	.01222	.9999	.3	.3
.8	.8	.01396	.9999	.2	.2
.9	.9	.01571	.9999	.1	.1
181.0	1.0	0.01745	0.9998	179.0	359.0
.1	.1	.01920	.9998	.9	.9
.2	.2	.02094	.9998	.8	.8
.3	.3	.02269	.9997	.7	.7
.4	.4	.02443	.9997	.6	.6
.5	.5	.02618	.9997	.5	.5
.6	.6	.02792	.9996	.4	.4
.7	.7	.02967	.9996	.3	.3
.8	.8	.03141	.9995	.2	.2
.9	.9	.03316	.9995	.1	.1
182.0	2.0	0.03490	0.9994	178.0	358.0
.1	.1	.03664	.9993	.9	.9
.2	.2	.03339	.9993	.8	.8
.3	.3	.04013	.9992	.7	.7
.4	.4	.04188	.9991	.6	.6
.5	.5	.04362	.9990	.5	.5
.6	.6	.04536	.9990	.4	.4
.7	.7	.04711	.9989	.3	.3
.8	.8	.04885	.9988	.2	.2
.9	.9	.05059	.9987	.1	.1
183.0	3.0	0.05234	0.9986	177.0	357.0
.1	.1	.05408	.9985	.9	.9
.2	.2	.05582	.9984	.8	.8
.3	.3	.05756	.9983	.7	.7
.4	.4	.05931	.9982	.6	.6
.5	.5	.06105	.9981	.5	.5
.6	.6	.06279	.9980	.4	.4
.7	.7	.06453	.9979	.3	.3
.8	.8	.06627	.9978	.2	.2
.9	.9	.06802	.9977	.1	.1

READ UP

− − SIN COS	+ + SIN COS	SIN	COS	+ − SIN COS	− + SIN COS
184.0	4.0	0.06976	0.9976	176.0	356.0
.1	.1	.07150	.9974	.9	.9
.2	.2	.07324	.9973	.8	.8
.3	.3	.07498	.9972	.7	.7
.4	.4	.07672	.9971	.6	.6
.5	.5	.07846	.9969	.5	.5
.6	.6	.08020	.9968	.4	.4
.7	.7	.08194	.9966	.3	.3
.8	.8	.08368	.9965	.2	.2
.9	.9	.08542	.9963	.1	.1
185.0	5.0	0.08716	0.9962	175.0	355.0
.1	.1	.08889	.9960	.9	.9
.2	.2	.09063	.9959	.8	.8
.3	.3	.09237	.9957	.7	.7
.4	.4	.09411	.9956	.6	.6
.5	.5	.09585	.9954	.5	.5
.6	.6	.09758	.9952	.4	.4
.7	.7	.09932	.9951	.3	.3
.8	.8	.10106	.9949	.2	.2
.9	.9	.10279	.9947	.1	.1
186.0	6.0	0.10453	0.9945	174.0	354.0
.1	.1	.10626	.9943	.9	.9
.2	.2	.10800	.9942	.8	.8
.3	.3	.10973	.9940	.7	.7
.4	.4	.11147	.9938	.6	.6
.5	.5	.11320	.9936	.5	.5
.6	.6	.11494	.9934	.4	.4
.7	.7	.11667	.9932	.3	.3
.8	.8	.11840	.9930	.2	.2
.9	.9	.12014	.9928	.1	.1
187.0	7.0	0.12187	0.9925	173.0	353.0
.1	.1	.12360	.9923	.9	.9
.2	.2	.12533	.9921	.8	.8
.3	.3	.12706	.9919	.7	.7
.4	.4	.12880	.9917	.6	.6
.5	.5	.13053	.9914	.5	.5
.6	.6	.13226	.9912	.4	.4
.7	.7	.13399	.9910	.3	.3
.8	.8	.13572	.9907	.2	.2
.9	.9	.13744	.9905	.1	.1

SIN − COS −	SIN + COS +	SIN	COS	SIN + COS −	SIN − COS +
188.0	8.0	0.13917	0.9903	172.0	352.0
.1	.1	.14090	.9900	.9	.9
.2	.2	.14263	.9898	.8	.8
.3	.3	.14436	.9895	.7	.7
.4	.4	.14608	.9893	.6	.6
.5	.5	.14781	.9890	.5	.5
.6	.6	.14954	.9888	.4	.4
.7	.7	.15126	.9885	.3	.3
.8	.8	.15299	.9882	.2	.2
.9	.9	.15471	.9880	.1	.1
189.0	9.0	0.15643	0.9877	171.0	351.0
.1	.1	.15816	.9874	.9	.9
.2	.2	.15988	.9871	.8	.8
.3	.3	.16160	.9869	.7	.7
.4	.4	.16333	.9866	.6	.6
.5	.5	.16505	.9863	.5	.5
.6	.6	.16677	.9860	.4	.4
.7	.7	.16849	.9857	.3	.3
.8	.8	.17021	.9854	.2	.2
.9	.9	.17193	.9851	.1	.1
190.0	10.0	0.1736	0.9848	170.0	350.0
.1	.1	.1754	.9845	.9	.9
.2	.2	.1771	.9842	.8	.8
.3	.3	.1788	.9839	.7	.7
.4	.4	.1805	.9836	.6	.6
.5	.5	.1822	.9833	.5	.5
.6	.6	.1840	.9829	.4	.4
.7	.7	.1857	.9826	.3	.3
.8	.8	.1874	.9823	.2	.2
.9	.9	.1891	.9820	.1	.1
191.0	11.0	0.1908	0.9816	169.0	349.0
.1	.1	.1925	.9813	.9	.9
.2	.2	.1942	.9810	.8	.8
.3	.3	.1959	.9806	.7	.7
.4	.4	.1977	.9803	.6	.6
.5	.5	.1994	.9799	.5	.5
.6	.6	.2011	.9796	.4	.4
.7	.7	.2028	.9792	.3	.3
.8	.8	.2045	.9789	.2	.2
.9	.9	.2062	.9785	.1	.1

SIN − COS −	SIN + COS +	SIN	COS	SIN + COS −	SIN − COS +
192.0	12.0	0.2079	0.9781	168.0	348.0
.1	.1	.2096	.9778	.9	.9
.2	.2	.2113	.9774	.8	.8
.3	.3	.2130	.9770	.7	.7
.4	.4	.2147	.9767	.6	.6
.5	.5	.2164	.9763	.5	.5
.6	.6	.2181	.9759	.4	.4
.7	.7	.2198	.9755	.3	.3
.8	.8	.2215	.9751	.2	.2
.9	.9	.2233	.9748	.1	.1
193.0	13.0	0.2250	0.9744	167.0	347.0
.1	.1	.2267	.9740	.9	.9
.2	.2	.2284	.9736	.8	.8
.3	.3	.2300	.9732	.7	.7
.4	.4	.2317	.9728	.6	.6
.5	.5	.2334	.9724	.5	.5
.6	.6	.2351	.9720	.4	.4
.7	.7	.2368	.9715	.3	.3
.8	.8	.2385	.9711	.2	.2
.9	.9	.2402	.9707	.1	.1
194.0	14.0	0.2419	0.9703	166.0	346.0
.1	.1	.2436	.9699	.9	.9
.2	.2	.2453	.9694	.8	.8
.3	.3	.2470	.9690	.7	.7
.4	.4	.2487	.9686	.6	.6
.5	.5	.2504	.9681	.5	.5
.6	.6	.2521	.9677	.4	.4
.7	.7	.2538	.9673	.3	.3
.8	.8	.2554	.9668	.2	.2
.9	.9	.2571	.9664	.1	.1
195.0	15.0	0.2588	0.9659	165.0	345.0
.1	.1	.2605	.9655	.9	.9
.2	.2	.2622	.9650	.8	.8
.3	.3	.2639	.9646	.7	.7
.4	.4	.2656	.9641	.6	.6
.5	.5	.2672	.9636	.5	.5
.6	.6	.2689	.9632	.4	.4
.7	.7	.2706	.9627	.3	.3
.8	.8	.2723	.9622	.2	.2
.9	.9	.2740	.9617	.1	.1

− − SIN COS	+ + SIN COS	SIN	COS	+ − SIN COS	− + SIN COS
196.0	16.0	0.2756	0.9613	164.0	344.0
.1	.1	.2773	.9608	.9	.9
.2	.2	.2790	.9603	.8	.8
.3	.3	.2807	.9598	.7	.7
.4	.4	.2823	.9593	.6	.6
.5	.5	.2840	.9588	.5	.5
.6	.6	.2857	.9583	.4	.4
.7	.7	.2874	.9578	.3	.3
.8	.8	.2890	.9573	.2	.2
.9	.9	.2907	.9568	.1	.1
197.0	17.0	0.2924	0.9563	163.0	343.0
.1	.1	.2940	.9558	.9	.9
.2	.2	.2957	.9553	.8	.8
.3	.3	.2974	.9548	.7	.7
.4	.4	.2990	.9542	.6	.6
.5	.5	.3007	.9537	.5	.5
.6	.6	.3024	.9532	.4	.4
.7	.7	.3040	.9527	.3	.3
.8	.8	.3057	.9521	.2	.2
.9	.9	.3074	.9516	.1	.1
198.0	18.0	0.3090	0.9511	162.0	342.0
.1	.1	.3107	.9505	.9	.9
.2	.2	.3123	.9500	.8	.8
.3	.3	.3140	.9494	.7	.7
.4	.4	.3156	.9489	.6	.6
.5	.5	.3173	.9483	.5	.5
.6	.6	.3190	.9478	.4	.4
.7	.7	.3206	.9472	.3	.3
.8	.8	.3223	.9466	.2	.2
.9	.9	.3239	.9461	.1	.1
199.0	19.0	0.3256	0.9455	161.0	341.0
.1	.1	.3272	.9449	.9	.9
.2	.2	.3289	.9444	.8	.8
.3	.3	.3305	.9438	.7	.7
.4	.4	.3322	.9432	.6	.6
.5	.5	.3338	.9426	.5	.5
.6	.6	.3355	.9421	.4	.4
.7	.7	.3371	.9415	.3	.3
.8	.8	.3387	.9409	.2	.2
.9	.9	.3404	.9403	.1	.1

SIN − COS −	SIN + COS +	SIN	COS	SIN + COS −	SIN − COS +
200.0	20.0	0.3420	0.9397	160.0	340.0
.1	.1	.3437	.9391	.9	.9
.2	.2	.3453	.9385	.8	.8
.3	.3	.3469	.9379	.7	.7
.4	.4	.3486	.9373	.6	.6
.5	.5	.3502	.9367	.5	.5
.6	.6	.3518	.9361	.4	.4
.7	.7	.3535	.9354	.3	.3
.8	.8	.3551	.9348	.2	.2
.9	.9	.3567	.9342	.1	.1
201.0	21.0	0.3584	0.9336	159.0	339.0
.1	.1	.3600	.9330	.9	.9
.2	.2	.3616	.9323	.8	.8
.3	.3	.3633	.9317	.7	.7
.4	.4	.3649	.9311	.6	.6
.5	.5	.3665	.9304	.5	.5
.6	.6	.3681	.9298	.4	.4
.7	.7	.3697	.9291	.3	.3
.8	.8	.3714	.9285	.2	.2
.9	.9	.3730	.9278	.1	.1
202.0	22.0	0.3746	0.9272	158.0	338.0
.1	.1	.3762	.9265	.9	.9
.2	.2	.3778	.9259	.8	.8
.3	.3	.3795	.9252	.7	.7
.4	.4	.3811	.9245	.6	.6
.5	.5	.3827	.9239	.5	.5
.6	.6	.3843	.9232	.4	.4
.7	.7	.3859	.9225	.3	.3
.8	.8	.3875	.9219	.2	.2
.9	.9	.3891	.9212	.1	.1
203.0	23.0	0.3907	0.9205	157.0	337.0
.1	.1	.3923	.9198	.9	.9
.2	.2	.3939	.9191	.8	.8
.3	.3	.3955	.9184	.7	.7
.4	.4	.3971	.9178	.6	.6
.5	.5	.3987	.9171	.5	.5
.6	.6	.4003	.9164	.4	.4
.7	.7	.4019	.9157	.3	.3
.8	.8	.4035	.9150	.2	.2
.9	.9	.4051	.9143	.1	.1

- SIN - COS	+ SIN + COS	SIN	COS	+ SIN - COS	- SIN + COS
204.0	24.0	0.4067	0.9135	156.0	336.0
.1	.1	.4083	.9128	.9	.9
.2	.2	.4099	.9121	.8	.8
.3	.3	.4115	.9114	.7	.7
.4	.4	.4131	.9107	.6	.6
.5	.5	.4147	.9100	.5	.5
.6	.6	.4163	.9092	.4	.4
.7	.7	.4179	.9085	.3	.3
.8	.8	.4195	.9078	.2	.2
.9	.9	.4210	.9070	.1	.1
205.0	25.0	0.4226	0.9063	155.0	335.0
.1	.1	.4242	.9056	.9	.9
.2	.2	.4258	.9048	.8	.8
.3	.3	.4274	.9041	.7	.7
.4	.4	.4289	.9033	.6	.6
.5	.5	.4305	.9026	.5	.5
.6	.6	.4321	.9018	.4	.4
.7	.7	.4337	.9011	.3	.3
.8	.8	.4352	.9003	.2	.2
.9	.9	.4368	.8996	.1	.1
206.0	26.0	0.4384	0.8988	154.0	334.0
.1	.1	.4399	.8980	.9	.9
.2	.2	.4415	.8973	.8	.8
.3	.3	.4431	.8965	.7	.7
.4	.4	.4446	.8957	.6	.6
.5	.5	.4462	.8949	.5	.5
.6	.6	.4478	.8942	.4	.4
.7	.7	.4493	.8934	.3	.3
.8	.8	.4509	.8926	.2	.2
.9	.9	.4524	.8918	.1	.1
207.0	27.0	0.4540	0.8910	153.0	333.0
.1	.1	.4555	.8902	.9	.9
.2	.2	.4571	.8894	.8	.8
.3	.3	.4586	.8886	.7	.7
.4	.4	.4602	.8878	.6	.6
.5	.5	.4617	.8870	.5	.5
.6	.6	.4633	.8862	.4	.4
.7	.7	.4648	.8854	.3	.3
.8	.8	.4664	.8846	.2	.2
.9	.9	.4679	.8838	.1	.1

− − SIN COS	+ + SIN COS	SIN	COS	+ − SIN COS	− + SIN COS
208.0	28.0	0.4695	0.8829	152.0	332.0
.1	.1	.4710	.8821	.9	.9
.2	.2	.4726	.8813	.8	.8
.3	.3	.4741	.8805	.7	.7
.4	.4	.4756	.8796	.6	.6
.5	.5	.4772	.8788	.5	.5
.6	.6	.4787	.8780	.4	.4
.7	.7	.4802	.8771	.3	.3
.8	.8	.4818	.8763	.2	.2
.9	.9	.4833	.8755	.1	.1
209.0	29.0	0.4848	0.8746	151.0	331.0
.1	.1	.4863	.8738	.9	.9
.2	.2	.4879	.8729	.8	.8
.3	.3	.4894	.8721	.7	.7
.4	.4	.4909	.8712	.6	.6
.5	.5	.4924	.8704	.5	.5
.6	.6	.4939	.8695	.4	.4
.7	.7	.4955	.8686	.3	.3
.8	.8	.4970	.8678	.2	.2
.9	.9	.4985	.8669	.1	.1
210.0	30.0	0.5000	0.8660	150.0	330.0
.1	.1	.5015	.8652	.9	.9
.2	.2	.5030	.8643	.8	.8
.3	.3	.5045	.8634	.7	.7
.4	.4	.5060	.8625	.6	.6
.5	.5	.5075	.8616	.5	.5
.6	.6	.5090	.8607	.4	.4
.7	.7	.5105	.8599	.3	.3
.8	.8	.5120	.8590	.2	.2
.9	.9	.5135	.8581	.1	.1
211.0	31.0	0.5150	0.8572	149.0	329.0
.1	.1	.5165	.8563	.9	.9
.2	.2	.5180	.8554	.8	.8
.3	.3	.5195	.8545	.7	.7
.4	.4	.5210	.8536	.6	.6
.5	.5	.5225	.8526	.5	.5
.6	.6	.5240	.8517	.4	.4
.7	.7	.5255	.8508	.3	.3
.8	.8	.5270	.8499	.2	.2
.9	.9	.5284	.8490	.1	.1

SIN − COS −	SIN + COS +	SIN	COS	SIN + COS −	SIN − COS +
212.0	32.0	0.5299	0.8480	148.0	328.0
.1	.1	.5314	.8471	.9	.9
.2	.2	.5329	.8462	.8	.8
.3	.3	.5344	.8453	.7	.7
.4	.4	.5358	.8443	.6	.6
.5	.5	.5373	.8434	.5	.5
.6	.6	.5388	.8425	.4	.4
.7	.7	.5402	.8415	.3	.3
.8	.8	.5417	.8406	.2	.2
.9	.9	.5432	.8396	.1	.1
213.0	33.0	0.5446	0.8387	147.0	327.0
.1	.1	.5461	.8377	.9	.9
.2	.2	.5476	.8368	.8	.8
.3	.3	.5490	.8358	.7	.7
.4	.4	.5505	.8348	.6	.6
.5	.5	.5519	.8339	.5	.5
.6	.6	.5534	.8329	.4	.4
.7	.7	.5548	.8320	.3	.3
.8	.8	.5563	.8310	.2	.2
.9	.9	.5577	.8300	.1	.1
214.0	34.0	0.5592	0.8290	146.0	326.0
.1	.1	.5606	.8281	.9	.9
.2	.2	.5621	.8271	.8	.8
.3	.3	.5635	.8261	.7	.7
.4	.4	.5650	.8251	.6	.6
.5	.5	.5664	.8241	.5	.5
.6	.6	.5678	.8231	.4	.4
.7	.7	.5693	.8221	.3	.3
.8	.8	.5707	.8211	.2	.2
.9	.9	.5721	.8202	.1	.1
215.0	35.0	0.5736	0.8192	145.0	325.0
.1	.1	.5750	.8181	.9	.9
.2	.2	.5764	.8171	.8	.8
.3	.3	.5779	.8161	.7	.7
.4	.4	.5793	.8151	.6	.6
.5	.5	.5807	.8141	.5	.5
.6	.6	.5821	.8131	.4	.4
.7	.7	.5835	.8121	.3	.3
.8	.8	.5850	.8111	.2	.2
.9	.9	.5864	.8100	.1	.1

− − SIN COS	+ + SIN COS	SIN	COS	+ − SIN COS	− + SIN COS
216.0	36.0	0.5878	0.8090	144.0	324.0
.1	.1	.5892	.8080	.9	.9
.2	.2	.5906	.8070	.8	.8
.3	.3	.5920	.8059	.7	.7
.4	.4	.5934	.8049	.6	.6
.5	.5	.5948	.8039	.5	.5
.6	.6	.5962	.8028	.4	.4
.7	.7	.5976	.8018	.3	.3
.8	.8	.5990	.8007	.2	.2
.9	.9	.6004	.7997	.1	.1
217.0	37.0	0.6018	0.7986	143.0	323.0
.1	.1	.6032	.7976	.9	.9
.2	.2	.6046	.7965	.8	.8
.3	.3	.6060	.7955	.7	.7
.4	.4	.6074	.7944	.6	.6
.5	.5	.6088	.7934	.5	.5
.6	.6	.6101	.7923	.4	.4
.7	.7	.6115	.7912	.3	.3
.8	.8	.6129	.7902	.2	.2
.9	.9	.6143	.7891	.1	.1
218.0	38.0	0.6157	0.7880	142.0	322.0
.1	.1	.6170	.7869	.9	.9
.2	.2	.6184	.7859	.8	.8
.3	.3	.6198	.7848	.7	.7
.4	.4	.6211	.7837	.6	.6
.5	.5	.6225	.7826	.5	.5
.6	.6	.6239	.7815	.4	.4
.7	.7	.6252	.7804	.3	.3
.8	.8	.6266	.7793	.2	.2
.9	.9	.6280	.7782	.1	.1
219.0	39.0	0.6293	0.7771	141.0	321.0
.1	.1	.6307	.7760	.9	.9
.2	.2	.6320	.7749	.8	.8
.3	.3	.6334	.7738	.7	.7
.4	.4	.6347	.7727	.6	.6
.5	.5	.6361	.7716	.5	.5
.6	.6	.6374	.7705	.4	.4
.7	.7	.6388	.7694	.3	.3
.8	.8	.6401	.7683	.2	.2
.9	.9	.6414	.7672	.1	.1

SIN − COS −	SIN + COS +	SIN	COS	SIN + COS −	SIN − COS +
220.0	40.0	0.6428	0.7660	140.0	320.0
.1	.1	.6441	.7649	.9	.9
.2	.2	.6455	.7638	.8	.8
.3	.3	.6468	.7627	.7	.7
.4	.4	.6481	.7615	.6	.6
.5	.5	.6494	.7604	.5	.5
.6	.6	.6508	.7593	.4	.4
.7	.7	.6521	.7581	.3	.3
.8	.8	.6534	.7570	.2	.2
.9	.9	.6547	.7559	.1	.1
221.0	41.0	0.6561	0.7547	139.0	319.0
.1	.1	.6574	.7536	.9	.9
.2	.2	.6587	.7524	.8	.8
.3	.3	.6600	.7513	.7	.7
.4	.4	.6613	.7501	.6	.6
.5	.5	.6626	.7490	.5	.5
.6	.6	.6639	.7478	.4	.4
.7	.7	.6652	.7466	.3	.3
.8	.8	.6665	.7455	.2	.2
.9	.9	.6678	.7443	.1	.1
222.0	42.0	0.6691	0.7431	138.0	318.0
.1	.1	.6704	.7420	.9	.9
.2	.2	.6717	.7408	.8	.8
.3	.3	.6730	.7396	.7	.7
.4	.4	.6743	.7385	.6	.6
.5	.5	.6756	.7373	.5	.5
.6	.6	.6769	.7361	.4	.4
.7	.7	.6782	.7349	.3	.3
.8	.8	.6794	.7337	.2	.2
.9	.9	.6807	.7325	.1	.1
223.0	43.0	0.6820	0.7314	137.0	317.0
.1	.1	.6833	.7302	.9	.9
.2	.2	.6845	.7290	.8	.8
.3	.3	.6858	.7278	.7	.7
.4	.4	.6871	.7266	.6	.6
.5	.5	.6884	.7254	.5	.5
.6	.6	.6896	.7242	.4	.4
.7	.7	.6909	.7230	.3	.3
.8	.8	.6921	.7218	.2	.2
.9	.9	.6934	.7206	.1	.1

SIN − COS −	SIN + COS +	SIN	COS	SIN + COS −	SIN − COS +
224.0	44.0	0.6947	0.7193	136.0	316.0
.1	.1	.6959	.7181	.9	.9
.2	.2	.6972	.7169	.8	.8
.3	.3	.6984	.7157	.7	.7
.4	.4	.6997	.7145	.6	.6
.5	.5	.7009	.7133	.5	.5
.6	.6	.7022	.7120	.4	.4
.7	.7	.7034	.7108	.3	.3
.8	.8	.7046	.7096	.2	.2
.9	.9	.7059	.7083	.1	.1
225.0	45.0	0.7071	0.7071	135.0	315.0
.1	.1	.7083	.7059	.9	.9
.2	.2	.7096	.7046	.8	.8
.3	.3	.7108	.7034	.7	.7
.4	.4	.7120	.7022	.6	.6
.5	.5	.7133	.7009	.5	.5
.6	.6	.7145	.6997	.4	.4
.7	.7	.7157	.6984	.3	.3
.8	.8	.7169	.6972	.2	.2
.9	.9	.7181	.6959	.1	.1
226.0	46.0	0.7193	0.6947	134.0	314.0
.1	.1	.7206	.6934	.9	.9
.2	.2	.7218	.6921	.8	.8
.3	.3	.7230	.6909	.7	.7
.4	.4	.7242	.6896	.6	.6
.5	.5	.7254	.6884	.5	.5
.6	.6	.7266	.6871	.4	.4
.7	.7	.7278	.6858	.3	.3
.8	.8	.7290	.6845	.2	.2
.9	.9	.7302	.6833	.1	.1
227.0	47.0	0.7314	0.6820	133.0	313.0
.1	.1	.7325	.6807	.9	.9
.2	.2	.7337	.6794	.8	.8
.3	.3	.7349	.6782	.7	.7
.4	.4	.7361	.6769	.6	.6
.5	.5	.7373	.6756	.5	.5
.6	.6	.7385	.6743	.4	.4
.7	.7	.7396	.6730	.3	.3
.8	.8	.7408	.6717	.2	.2
.9	.9	.7420	.6704	.1	.1

− − SIN COS	+ + SIN COS	SIN	COS	+ − SIN COS	− + SIN COS
228.0	48.0	0.7431	0.6691	132.0	312.0
.1	.1	.7443	.6678	.9	.9
.2	.2	.7455	.6665	.8	.8
.3	.3	.7466	.6652	.7	.7
.4	.4	.7478	.6639	.6	.6
.5	.5	.7490	.6626	.5	.5
.6	.6	.7501	.6613	.4	.4
.7	.7	.7513	.6600	.3	.3
.8	.8	.7524	.6587	.2	.2
.9	.9	.7536	.6574	.1	.1
229.0	49.0	0.7547	0.6561	131.0	311.0
.1	.1	.7559	.6547	.9	.9
.2	.2	.7570	.6534	.8	.8
.3	.3	.7581	.6521	.7	.7
.4	.4	.7593	.6508	.6	.6
.5	.5	.7604	.6494	.5	.5
.6	.6	.7615	.6481	.4	.4
.7	.7	.7627	.6468	.3	.3
.8	.8	.7638	.6455	.2	.2
.9	.9	.7649	.6441	.1	.1
230.0	50.0	0.7660	0.6428	130.0	310.0
.1	.1	.7672	.6414	.9	.9
.2	.2	.7683	.6401	.8	.8
.3	.3	.7694	.6388	.7	.7
.4	.4	.7705	.6374	.6	.6
.5	.5	.7716	.6361	.5	.5
.6	.6	.7727	.6347	.4	.4
.7	.7	.7738	.6334	.3	.3
.8	.8	.7749	.6320	.2	.2
.9	.9	.7760	.6307	.1	.1
231.0	51.0	0.7771	0.6293	129.0	309.0
.1	.1	.7782	.6280	.9	.9
.2	.2	.7793	.6266	.8	.8
.3	.3	.7804	.6252	.7	.7
.4	.4	.7815	.6239	.6	.6
.5	.5	.7826	.6225	.5	.5
.6	.6	.7837	.6211	.4	.4
.7	.7	.7848	.6198	.3	.3
.8	.8	.7859	.6184	.2	.2
.9	.9	.7869	.6170	.1	.1

− − SIN COS	+ + SIN COS	SIN	COS	+ − SIN COS	− + SIN COS
232.0	52.0	0.7880	0.6157	128.0	308.0
.1	.1	.7891	.6143	.9	.9
.2	.2	.7902	.6129	.8	.8
.3	.3	.7912	.6115	.7	.7
.4	.4	.7923	.6101	.6	.6
.5	.5	.7934	.6088	.5	.5
.6	.6	.7944	.6074	.4	.4
.7	.7	.7955	.6060	.3	.3
.8	.8	.7965	.6046	.2	.2
.9	.9	.7976	.6032	.1	.1
233.0	53.0	0.7986	0.6018	127.0	307.0
.1	.1	.7997	.6004	.9	.9
.2	.2	.8007	.5990	.8	.8
.3	.3	.8018	.5976	.7	.7
.4	.4	.8028	.5926	.6	.6
.5	.5	.8039	.5948	.5	.5
.6	.6	.8049	.5934	.4	.4
.7	.7	.8059	.5920	.3	.3
.8	.8	.8070	.5906	.2	.2
.9	.9	.8080	.5892	.1	.1
234.0	54.0	0.8090	0.5878	126.0	306.0
.1	.1	.8100	.5864	.9	.9
.2	.2	.8111	.5850	.8	.8
.3	.3	.8121	.5835	.7	.7
.4	.4	.8131	.5821	.6	.6
.5	.5	.8141	.5807	.5	.5
.6	.6	.8151	.5793	.4	.4
.7	.7	.8161	.5779	.3	.3
.8	.8	.8171	.5764	.2	.2
.9	.9	.8181	.5750	.1	.1
235.0	55.0	0.8192	0.5736	125.0	305.0
.1	.1	.8202	.5721	.9	.9
.2	.2	.8211	.5707	.8	.8
.3	.3	.8221	.5693	.7	.7
.4	.4	.8231	.5678	.6	.6
.5	.5	.8241	.5664	.5	.5
.6	.6	.8251	.5650	.4	.4
.7	.7	.8261	.5635	.3	.3
.8	.8	.8271	.5621	.2	.2
.9	.9	.8281	.5606	.1	.1

SIN − COS −	SIN + COS +	SIN	COS	SIN + COS −	SIN − COS +
236.0	56.0	0.8290	0.5592	124.0	304.0
.1	.1	.8300	.5577	.9	.9
.2	.2	.8310	.5563	.8	.8
.3	.3	.8320	.5548	.7	.7
.4	.4	.8329	.5534	.6	.6
.5	.5	.8339	.5519	.5	.5
.6	.6	.8348	.5505	.4	.4
.7	.7	.8358	.5490	.3	.3
.8	.8	.8368	.5476	.2	.2
.9	.9	.8377	.5461	.1	.1
237.0	57.0	0.8387	0.5446	123.0	303.0
.1	.1	.8396	.5432	.9	.9
.2	.2	.8406	.5417	.8	.8
.3	.3	.8415	.5402	.7	.7
.4	.4	.8425	.5388	.6	.6
.5	.5	.8434	.5373	.5	.5
.6	.6	.8443	.5358	.4	.4
.7	.7	.8453	.5344	.3	.3
.8	.8	.8462	.5329	.2	.2
.9	.9	.8471	.5314	.1	.1
238.0	58.0	0.8480	0.5299	122.0	302.0
.1	.1	.8490	.5284	.9	.9
.2	.2	.8499	.5270	.8	.8
.3	.3	.8508	.5255	.7	.7
.4	.4	.8517	.5240	.6	.6
.5	.5	.8526	.5225	.5	.5
.6	.6	.8536	.5210	.4	.4
.7	.7	.8545	.5195	.3	.3
.8	.8	.8554	.5180	.2	.2
.9	.9	.8563	.5165	.1	.1
239.0	59.0	0.8572	0.5150	121.0	301.0
.1	.1	.8581	.5135	.9	.9
.2	.2	.8590	.5120	.8	.8
.3	.3	.8599	.5105	.7	.7
.4	.4	.8607	.5090	.6	.6
.5	.5	.8616	.5075	.5	.5
.6	.6	.8625	.5060	.4	.4
.7	.7	.8634	.5045	.3	.3
.8	.8	.8643	.5030	.2	.2
.9	.9	.8652	.5015	.1	.1

SIN − COS −	SIN + COS +	SIN	COS	SIN + COS −	SIN − COS +
240.0	60.0	0.8660	0.5000	120.0	300.0
.1	.1	.8669	.4985	.9	.9
.2	.2	.8678	.4970	.8	.8
.3	.3	.8686	.4955	.7	.7
.4	.4	.8695	.4939	.6	.6
.5	.5	.8704	.4924	.5	.5
.6	.6	.8712	.4909	.4	.4
.7	.7	.8721	.4894	.3	.3
.8	.8	.8729	.4879	.2	.2
.9	.9	.8738	.4863	.1	.1
241.0	61.0	0.8746	0.4848	119.0	299.0
.1	.1	.8755	.4833	.9	.9
.2	.2	.8763	.4818	.8	.8
.3	.3	.8771	.4802	.7	.7
.4	.4	.8780	.4787	.6	.6
.5	.5	.8788	.4772	.5	.5
.6	.6	.8796	.4756	.4	.4
.7	.7	.8805	.4741	.3	.3
.8	.8	.8813	.4726	.2	.2
.9	.9	.8821	.4710	.1	.1
242.0	62.0	0.8829	0.4695	118.0	298.0
.1	.1	.8838	.4679	.9	.9
.2	.2	.8846	.4664	.8	.8
.3	.3	.8854	.4648	.7	.7
.4	.4	.8862	.4633	.6	.6
.5	.5	.8870	.4617	.5	.5
.6	.6	.8878	.4602	.4	.4
.7	.7	.8886	.4586	.3	.3
.8	.8	.8894	.4571	.2	.2
.9	.9	.8902	.4555	.1	.1
243.0	63.0	0.8910	0.4540	117.0	297.0
.1	.1	.8918	.4524	.9	.9
.2	.2	.8926	.4509	.8	.8
.3	.3	.8934	.4493	.7	.7
.4	.4	.8942	.4478	.6	.6
.5	.5	.8949	.4462	.5	.5
.6	.6	.8957	.4446	.4	.4
.7	.7	.8965	.4431	.3	.3
.8	.8	.8973	.4415	.2	.2
.9	.9	.8980	.4399	.1	.1

SIN − COS −	SIN + COS +	SIN	COS	SIN + COS −	SIN − COS +
244.0	64.0	0.8988	0.4384	116.0	296.0
.1	.1	.8996	.4368	.9	.9
.2	.2	.9003	.4352	.8	.8
.3	.3	.9011	.4337	.7	.7
.4	.4	.9018	.4321	.6	.6
.5	.5	.9026	.4305	.5	.5
.6	.6	.9033	.4289	.4	.4
.7	.7	.9041	.4274	.3	.3
.8	.8	.9048	.4258	.2	.2
.9	.9	.9056	.4242	.1	.1
245.0	65.0	0.9063	0.4226	115.0	295.0
.1	.1	.9070	.4210	.9	.9
.2	.2	.9078	.4195	.8	.8
.3	.3	.9085	.4179	.7	.7
.4	.4	.9092	.4163	.6	.6
.5	.5	.9100	.4147	.5	.5
.6	.6	.9107	.4131	.4	.4
.7	.7	.9114	.4115	.3	.3
.8	.8	.9121	.4099	.2	.2
.9	.9	.9128	.4083	.1	.1
246.0	66.0	0.9135	0.4067	114.0	294.0
.1	.1	.9143	.4051	.9	.9
.2	.2	.9150	.4035	.8	.8
.3	.3	.9157	.4019	.7	.7
.4	.4	.9164	.4003	.6	.6
.5	.5	.9171	.3987	.5	.5
.6	.6	.9178	.3971	.4	.4
.7	.7	.9184	.3955	.3	.3
.8	.8	.9191	.3939	.2	.2
.9	.9	.9198	.3923	.1	.1
247.0	67.0	0.9205	0.3907	113.0	293.0
.1	.1	.9212	.3891	.9	.9
.2	.2	.9219	.3875	.8	.8
.3	.3	.9225	.3859	.7	.7
.4	.4	.9232	.3843	.6	.6
.5	.5	.9239	.3827	.5	.5
.6	.6	.9245	.3811	.4	.4
.7	.7	.9252	.3795	.3	.3
.8	.8	.9259	.3778	.2	.2
.9	.9	.9265	.3762	.1	.1

SIN − COS −	SIN + COS +	SIN	COS	SIN + COS −	SIN − COS +
248.0	68.0	0.9272	0.3746	112.0	292.0
.1	.1	.9278	.3730	.9	.9
.2	.2	.9285	.3714	.8	.8
.3	.3	.9291	.3697	.7	.7
.4	.4	.9298	.3681	.6	.6
.5	.5	.9304	.3665	.5	.5
.6	.6	.9311	.3649	.4	.4
.7	.7	.9317	.3633	.3	.3
.8	.8	.9323	.3616	.2	.2
.9	.9	.9330	.3600	.1	.1
249.0	69.0	0.9336	0.3584	111.0	291.0
.1	.1	.9342	.3567	.9	.9
.2	.2	.9348	.3551	.8	.8
.3	.3	.9354	.3535	.7	.7
.4	.4	.9361	.3518	.6	.6
.5	.5	.9367	.3502	.5	.5
.6	.6	.9373	.3486	.4	.4
.7	.7	.9379	.3469	.3	.3
.8	.8	.9385	.3453	.2	.2
.9	.9	.9391	.3437	.1	.1
250.0	70.0	0.9397	0.3420	110.0	290.0
.1	.1	.9403	.3404	.9	.9
.2	.2	.9409	.3387	.8	.8
.3	.3	.9415	.3371	.7	.7
.4	.4	.9421	.3355	.6	.6
.5	.5	.9426	.3338	.5	.5
.6	.6	.9432	.3322	.4	.4
.7	.7	.9438	.3305	.3	.3
.8	.8	.9444	.3289	.2	.2
.9	.9	.9449	.3272	.1	.1
251.0	71.0	0.9455	0.3256	109.0	289.0
.1	.1	.9461	.3239	.9	.9
.2	.2	.9466	.3223	.8	.8
.3	.3	.9472	.3206	.7	.7
.4	.4	.9478	.3190	.6	.6
.5	.5	.9483	.3173	.5	.5
.6	.6	.9489	.3156	.4	.4
.7	.7	.9494	.3140	.3	.3
.8	.8	.9500	.3123	.2	.2
.9	.9	.9505	.3107	.1	.1

− − SIN COS	+ + SIN COS	SIN	COS	+ − SIN COS	− + SIN COS
252.0	72.0	0.9511	0.3090	108.0	288.0
.1	.1	.9516	.3074	.9	.9
.2	.2	.9521	.3057	.8	.8
.3	.3	.9527	.3040	.7	.7
.4	.4	.9532	.3024	.6	.6
.5	.5	.9537	.3007	.5	.5
.6	.6	.9542	.2990	.4	.4
.7	.7	.9548	.2974	.3	.3
.8	.8	.9553	.2957	.2	.2
.9	.9	.9558	.2940	.1	.1
253.0	73.0	0.9563	0.2924	107.0	287.0
.1	.1	.9568	.2907	.9	.9
.2	.2	.9573	.2890	.8	.8
.3	.3	.9578	.2874	.7	.7
.4	.4	.9583	.2857	.6	.6
.5	.5	.9588	.2840	.5	.5
.6	.6	.9593	.2823	.4	.4
.7	.7	.9598	.2807	.3	.3
.8	.8	.9603	.2790	.2	.2
.9	.9	.9608	.2773	.1	.1
254.0	74.0	0.9613	0.2756	106.0	286.0
.1	.1	.9617	.2740	.9	.9
.2	.2	.9622	.2723	.8	.8
.3	.3	.9627	.2706	.7	.7
.4	.4	.9632	.2689	.6	.6
.5	.5	.9636	.2672	.5	.5
.6	.6	.9641	.2656	.4	.4
.7	.7	.9646	.2639	.3	.3
.8	.8	.9650	.2622	.2	.2
.9	.9	.9655	.2605	.1	.1
255.0	75.0	0.9659	0.2588	105.0	185.0
.1	.1	.9664	.2571	.9	.9
.2	.2	.9668	.2554	.8	.8
.3	.3	.9673	.2538	.7	.7
.4	.4	.9677	.2521	.6	.6
.5	.5	.9681	.2504	.5	.5
.6	.6	.9686	.2487	.4	.4
.7	.7	.9690	.2470	.3	.3
.8	.8	.9694	.2453	.2	.2
.9	.9	.9699	.2436	.1	.1

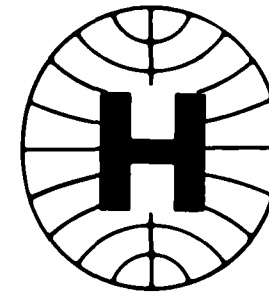
SIN − COS −	SIN + COS +	SIN	COS	SIN + COS −	SIN − COS +
256.0	76.0	0.9703	0.2419	104.0	184.0
.1	.1	.9707	.2402	.9	.9
.2	.2	.9711	.2385	.8	.8
.3	.3	.9715	.2368	.7	.7
.4	.4	.9720	.2351	.6	.6
.5	.5	.9724	.2334	.5	.5
.6	.6	.9728	.2317	.4	.4
.7	.7	.9732	.2300	.3	.3
.8	.8	.9736	.2284	.2	.2
.9	.9	.9740	.2267	.1	.1
257.0	77.0	0.9744	0.2250	103.0	183.0
.1	.1	.9748	.2233	.9	.9
.2	.2	.9751	.2215	.8	.8
.3	.3	.9755	.2198	.7	.7
.4	.4	.9759	.2181	.6	.6
.5	.5	.9763	.2164	.5	.5
.6	.6	.9767	.2147	.4	.4
.7	.7	.9770	.2130	.3	.3
.8	.8	.9774	.2113	.2	.2
.9	.9	.9778	.2098	.1	.1
258.0	78.0	0.9781	0.2079	102.0	182.0
.1	.1	.9785	.2062	.9	.9
.2	.2	.9789	.2045	.8	.8
.3	.3	.9792	.2028	.7	.7
.4	.4	.9796	.2011	.6	.6
.5	.5	.9799	.1994	.5	.5
.6	.6	.9803	.1977	.4	.4
.7	.7	.9806	.1959	.3	.3
.8	.8	.9810	.1942	.2	.2
.9	.9	.9813	.1925	.1	.1
259.0	79.0	0.9816	0.1908	101.0	181.0
.1	.1	.9820	.1891	.9	.9
.2	.2	.9823	.1874	.8	.8
.3	.3	.9826	.1857	.7	.7
.4	.4	.9829	.1840	.6	.6
.5	.5	.9833	.1822	.5	.5
.6	.6	.9836	.1805	.4	.4
.7	.7	.9839	.1788	.3	.3
.8	.8	.9842	.1771	.2	.2
.9	.9	.9845	.1754	.1	.1

SIN − COS −	SIN + COS +	SIN	COS	SIN + COS −	SIN − COS +
260.0	80.0	0.9848	0.17360	100.0	280.0
.1	.1	.9851	.17193	.9	.9
.2	.2	.9854	.17021	.8	.8
.3	.3	.9857	.16849	.7	.7
.4	.4	.9860	.16677	.6	.6
.5	.5	.9863	.16505	.5	.5
.6	.6	.9866	.16333	.4	.4
.7	.7	.9869	.16160	.3	.3
.8	.8	.9871	.15988	.2	.2
.9	.9	.9874	.15816	.1	.1
261.0	81.0	0.9877	0.15643	99.0	279.0
.1	.1	.9880	.15471	.9	.9
.2	.2	.9882	.15299	.8	.8
.3	.3	.9885	.15126	.7	.7
.4	.4	.9888	.14954	.6	.6
.5	.5	.9890	.14781	.5	.5
.6	.6	.9893	.14608	.4	.4
.7	.7	.9895	.14436	.3	.3
.8	.8	.9898	.14263	.2	.2
.9	.9	.9900	.14090	.1	.1
262.0	82.0	0.9903	0.13917	98.0	278.0
.1	.1	.9905	.13744	.9	.9
.2	.2	.9907	.13572	.8	.8
.3	.3	.9910	.13399	.7	.7
.4	.4	.9912	.13226	.6	.6
.5	.5	.9914	.13053	.5	.5
.6	.6	.9917	.12880	.4	.4
.7	.7	.9919	.12706	.3	.3
.8	.8	.9921	.12533	.2	.2
.9	.9	.9923	.12360	.1	.1
263.0	83.0	0.9925	0.12187	97.0	277.0
.1	.1	.9928	.12014	.9	.9
.2	.2	.9930	.11840	.8	.8
.3	.3	.9932	.11667	.7	.7
.4	.4	.9934	.11494	.6	.6
.5	.5	.9936	.11320	.5	.5
.6	.6	.9938	.11147	.4	.4
.7	.7	.9940	.10973	.3	.3
.8	.8	.9942	.10800	.2	.2
.9	.9	.9943	.10626	.1	.1

− − SIN COS	+ + SIN COS	SIN	COS	+ − SIN COS	− + SIN COS
264.0	84.0	0.9945	0.10453	96.0	276.0
.1	.1	.9947	.10279	.9	.9
.2	.2	.9949	.10106	.8	.8
.3	.3	.9951	.09932	.7	.7
.4	.4	.9952	.09758	.6	.6
.5	.5	.9954	.09585	.5	.5
.6	.6	.9956	.09411	.4	.4
.7	.7	.9957	.09237	.3	.3
.8	.8	.9959	.09063	.2	.2
.9	.9	.9960	.08889	.1	.1
265.0	85.0	0.9962	0.08716	95.0	275.0
.1	.1	.9963	.08542	.9	.9
.2	.2	.9965	.08368	.8	.8
.3	.3	.9966	.08194	.7	.7
.4	.4	.9968	.08020	.6	.6
.5	.5	.9969	.07846	.5	.5
.6	.6	.9971	.07672	.4	.4
.7	.7	.9972	.07498	.3	.3
.8	.8	.9973	.07324	.2	.2
.9	.9	.9974	.07150	.1	.1
266.0	86.0	0.9976	0.06976	94.0	274.0
.1	.1	.9977	.06802	.9	.9
.2	.2	.9978	.06627	.8	.8
.3	.3	.9979	.06453	.7	.7
.4	.4	.9980	.06279	.6	.6
.5	.5	.9981	.06105	.5	.5
.6	.6	.9982	.05931	.4	.4
.7	.7	.9983	.05756	.3	.3
.8	.8	.9984	.05582	.2	.2
.9	.9	.9985	.05408	.1	.1
267.0	87.0	0.9986	0.05234	93.0	273.0
.1	.1	.9987	.05059	.9	.9
.2	.2	.9988	.04885	.8	.8
.3	.3	.9989	.04711	.7	.7
.4	.4	.9990	.04536	.6	.6
.5	.5	.9990	.04362	.5	.5
.6	.6	.9991	.04188	.4	.4
.7	.7	.9992	.04013	.3	.3
.8	.8	.9993	.03839	.2	.2
.9	.9	.9993	.03664	.1	.1

− − SIN COS	+ + SIN COS	SIN	COS	+ − SIN COS	− + SIN COS
268.0	88.0	0.9994	0.03490	92.0	272.0
.1	.1	.9995	.03316	.9	.9
.2	.2	.9995	.03141	.8	.8
.3	.3	.9996	.02967	.7	.7
.4	.4	.9996	.02792	.6	.6
.5	.5	.9997	.02618	.5	.5
.6	.6	.9997	.02443	.4	.4
.7	.7	.9997	.02269	.3	.3
.8	.8	.9998	.02094	.2	.2
.9	.9	.9998	.01920	.1	.1
269.0	89.0	0.9998	0.01745	91.0	271.0
.1	.1	.9999	.01571	.9	.9
.2	.2	.9999	.01396	.8	.8
.3	.3	.9999	.01222	.7	.7
.4	.4	.9999	.01047	.6	.6
.5	.5	1.0000	.00873	.5	.5
.6	.6	1.0000	.00698	.4	.4
.7	.7	1.0000	.00524	.3	.3
.8	.8	1.0000	.00349	.2	.2
.9	.9	1.0000	.00175	.1	.1
270.0	90.0	1.0000	.00000	90.0	270.0

Appendix

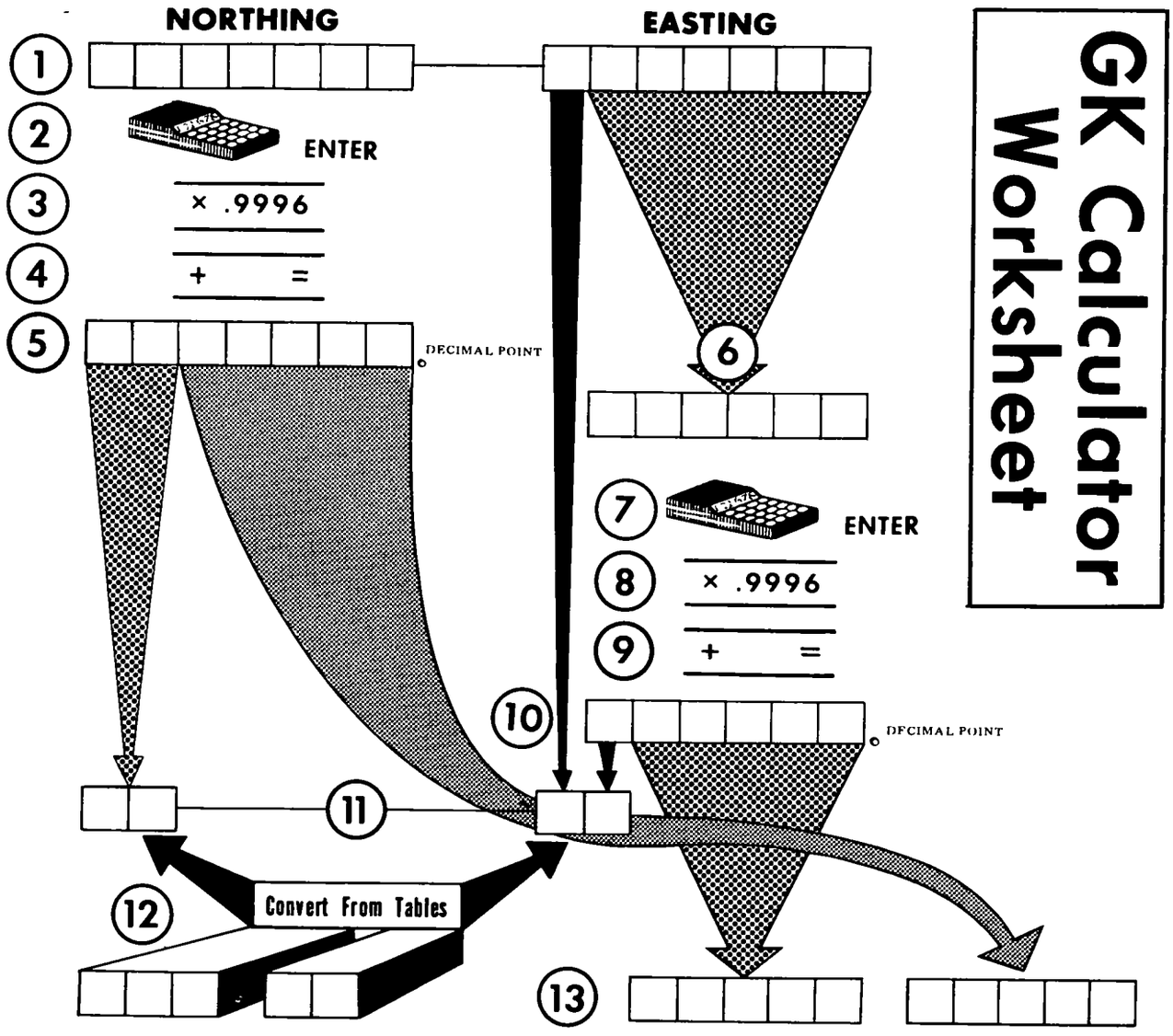


WORKSHEETS

This appendix contains blank calculator, graph, and difference table worksheets that may be reproduced for field use. Please note that calculator worksheet numbers ④ and ⑨ have been purposely left blank to permit the use of different zone formulas.

GK Calculator Worksheet

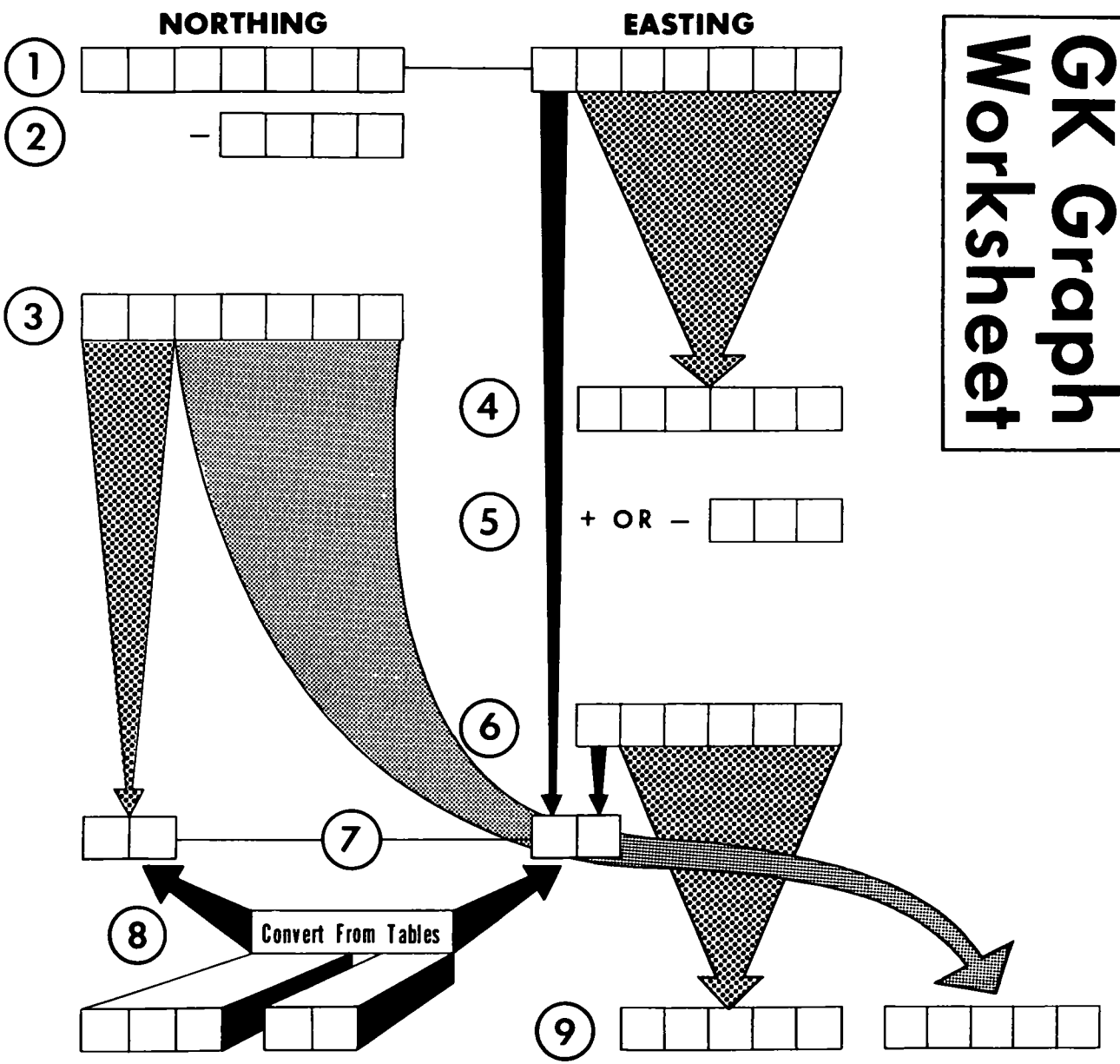
1. RECORD GK GRID IN BLOCKS AT RIGHT.
2. ENTER NORTHING IN CALCULATOR.
3. MULTIPLY BY .9996.
4. ADD _____
5. RECORD DIGITS TO LEFT OF DECIMAL POINT. OMIT DIGITS AFTER DECIMAL.
6. COPY LAST 6 DIGITS FROM STEP 1 EASTING AND ENTER AT FAR RIGHT AS SHOWN BY ARROW.
7. ENTER IN CALCULATOR.
8. MULTIPLY BY .9996.
9. ADD _____
10. RECORD DIGITS TO LEFT OF DECIMAL POINT.
11. COPY DIGITS FROM STEPS 5, 1, AND 10 AS SHOWN BY ARROWS.
12. CONVERT TO UTM USING THE BLOCK CONVERSION TABLES (APPENDIX E).
13. COPY LAST 5 DIGITS FROM STEPS 5 AND 10 AS SHOWN BY ARROWS.



STEPS 12 AND 13 ARE THE UTM MILITARY GRID

GK Graph Worksheet

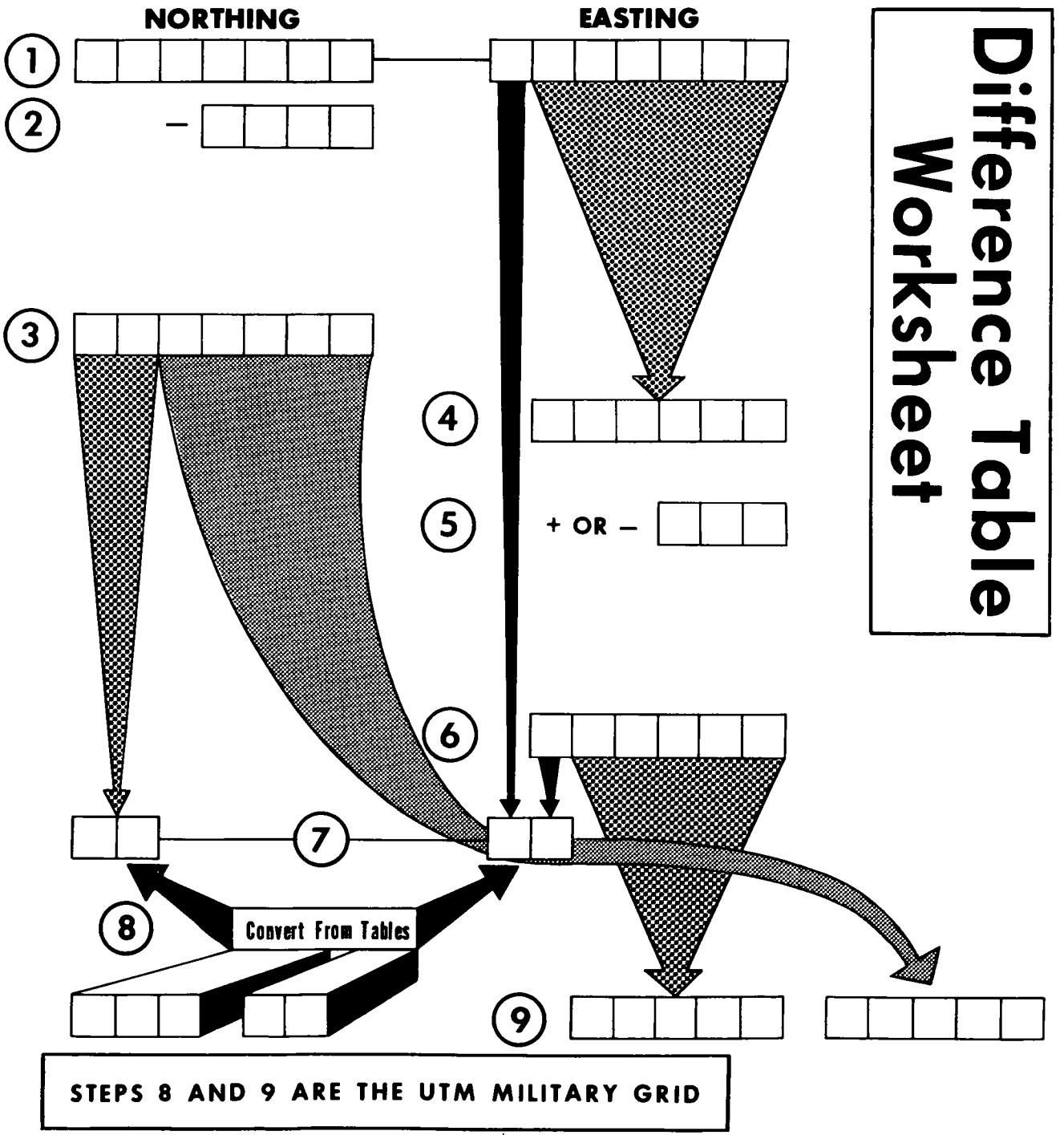
1. RECORD GK GRID IN BLOCKS AT RIGHT.
2. FIND THE NORTHING DIFFERENCE (ΔX). READ FROM GK NORTHING GRID ACROSS TO DIAGONAL LINE ON CHART THEN READ DOWN TO FIND THE CORRESPONDING VALUE FOR ΔX. ENTER ΔX IN THE (2) BLOCKS
3. SUBTRACT ΔX FROM STEP 1 AND ENTER HERE
4. COPY LAST 6 DIGITS FROM STEP 1 EASTING AND ENTER AT FAR RIGHT AS SHOWN BY ARROW.
5. FIND THE EASTING DIFFERENCE (ΔY) GO TO EASTING GRAPH READ FROM GK EASTING GRID ACROSS TO DIAGONAL LINE ON THE GRAPH. READ DOWN TO FIND THE CORRESPONDING VALUE FOR ΔY ENTER ΔY IN THE (5) BLOCKS.
6. IF THE ΔY VALUE IS POSITIVE, *ADD* TO STEP 1. IF THE ΔY VALUE IS NEGATIVE, *SUBTRACT* FROM STEP 1.
7. COPY DIGITS FROM STEPS 3, 1, AND 6 AS SHOWN BY THE ARROWS.
8. CONVERT TO UTM USING THE BLOCK CONVERSION TABLES (APPENDIX E)
9. COPY LAST 5 DIGITS FROM STEPS 3 AND 6 AS SHOWN BY ARROWS



STEPS 8 AND 9 ARE THE UTM MILITARY GRID

Difference Table Worksheet

1. RECORD GK GRID IN BLOCKS AT RIGHT.
2. FIND THE NORTHING DIFFERENCE (ΔX). DETERMINE THE APPROPRIATE GK NORTHING (X) NUMERICAL SPREAD. READ ACROSS TO THE DELTA X (ΔX) AND FIND THE DESIRED ZONE (INDICATED BY THE FIRST NUMBER IN THE GK EASTING). DETERMINE Δ X AND ENTER IN THE (2) BLOCKS.
3. SUBTRACT Δ X FROM STEP **1** AND ENTER HERE.
4. COPY LAST 6 DIGITS FROM STEP **1** EASTING AND ENTER AT FAR RIGHT AS SHOWN BY ARROW.
5. FIND THE EASTING DIFFERENCE (ΔY). GO TO THE GK EASTING DIFFERENCE TABLES. DETERMINE THE APPROPRIATE **GK** EASTING (Y) NUMERICAL SPREAD. READ ACROSS TO THE **DELTA** Y (ΔY) AND FIND THE DESIRED ZONE. DETERMINE ΔY AND ENTER IN THE (5) BLOCKS.
6. IF THE ΔY VALUE IS POSITIVE, *ADD* TO STEP **1**. IF THE ΔY VALUE IS NEGATIVE, *SUBTRACT* FROM STEP **1**.
7. COPY DIGITS FROM STEPS **3**, **1** AND **6** AS SHOWN BY THE ARROWS.
8. CONVERT TO UTM USING THE BLOCK CONVERSION TABLES (APPENDIX E).
9. COPY LAST 5 DIGITS FROM STEPS **3** AND **6** AS SHOWN BY ARROWS.



FM 34-85

25 SEPTEMBER 1981

By Order of the Secretary of the Army:

E. C. MEYER
General, United States Army
Chief of Staff

Official:

ROBERT M. JOYCE
Brigadier General, United States Army
The Adjutant General

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Conversion Formulas

THE FOLLOWING C AND D VALUES FOR EACH ZONE HAVE BEEN ROUNDED OFF FOR YOUR CONVENIENCE.

ZONE 1	(42–54N)	N	.9996X + 47
		E	.9996Y + 157
ZONE 2	(42–57N)	N	.9996X + 52
		E	.9996Y + 147
ZONE 3	(42–57N)	N	.9996X + 55
		E	.9996Y + 137
ZONE 4	(40–60N)	N	.9996X + 61
		E	.9996Y + 129
ZONE 5	(40–60N)	N	.9996X + 67
		E	.9996Y + 120
	(NORWAY)		
ZONE 4	(69–71N)	N	.9996X + 64
		E	.9996Y + 134
ZONE 5	(69–71N)	N	.9996X + 70
		E	.9996Y + 126

RUSSIAN GAUSS–KRASOVSKIJ COORDINATES PULKOVA 1942 DATUM ARE CONVERTED TO EUROPEAN DATUM UTM MILITARY COORDINATES BY THE FOLLOWING FORMULAS:

WHERE:

N = .9996X + C

E = .9996Y + D

N = UTM grid northing

E = UTM grid easting

X = Russian Gauss-Krasavskij grid northing

Y = Russian Gauss-Krasavskij grid easting with zone number removed

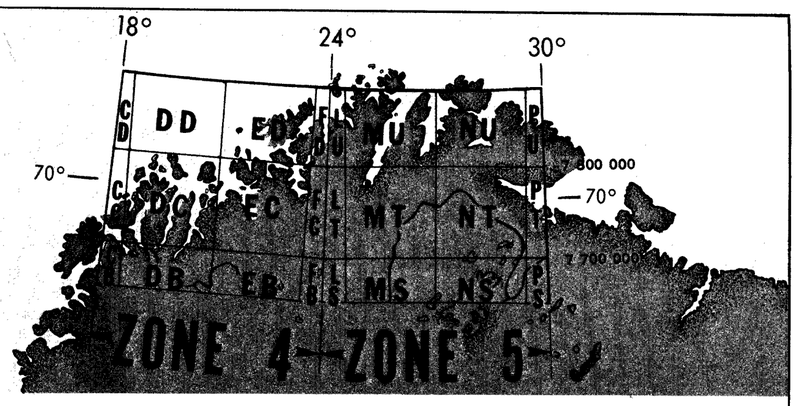
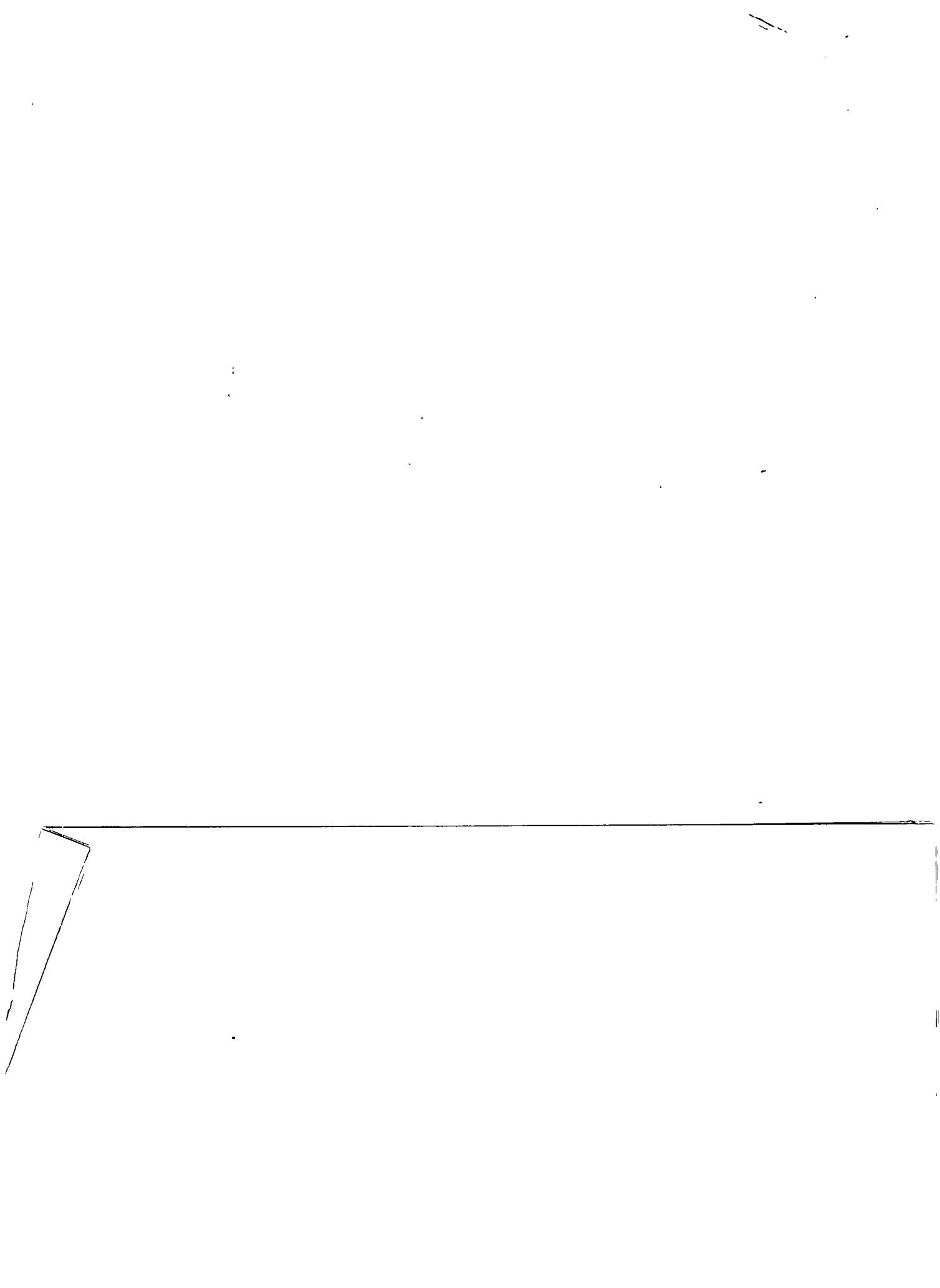


TABLE 1

C AND D VALUES

ZONE	1(31)	2(32)	3(33)	4(34)	4(34)	5(35)	5(35)
C. M.	3E	9E	15E	21E	21E	27E	27E
ø (N)	42–54N	42–57N	42–57N	40–60N	69–71N	40–60N	69–71N
C	47.15	51.71	55.36	60.67	64.10	66.56	69.71
D	156.72	146.86	137.38	128.63	133.96	120.10	125.87

NOTE: THE RUSSIAN GAUSS-KRASOVSKIJ ZONES ARE NUMBERED 1 THRU 5 AND THE CORRESPONDING UTM ZONE NUMBERS ARE 31 THRU 35.



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